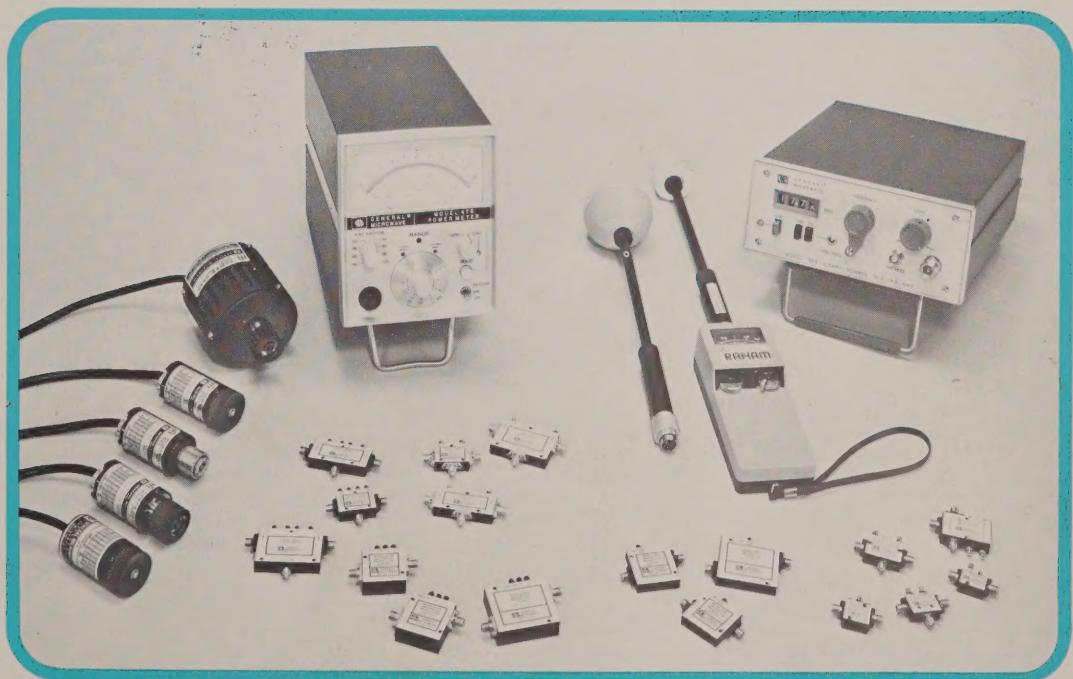


Oct 16

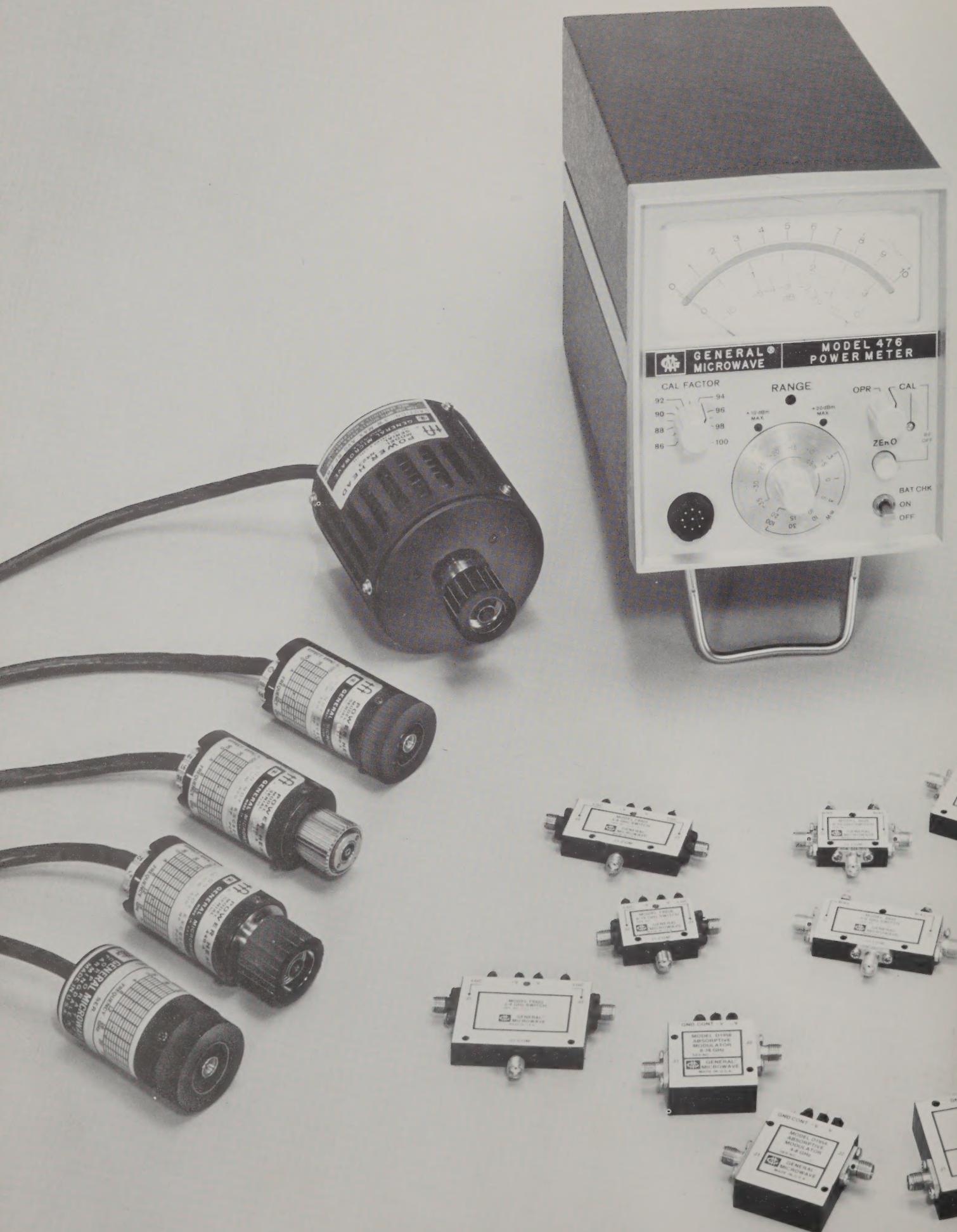


CATALOG 76

# General Microwave Corporation



**Microwave Instruments and Components**

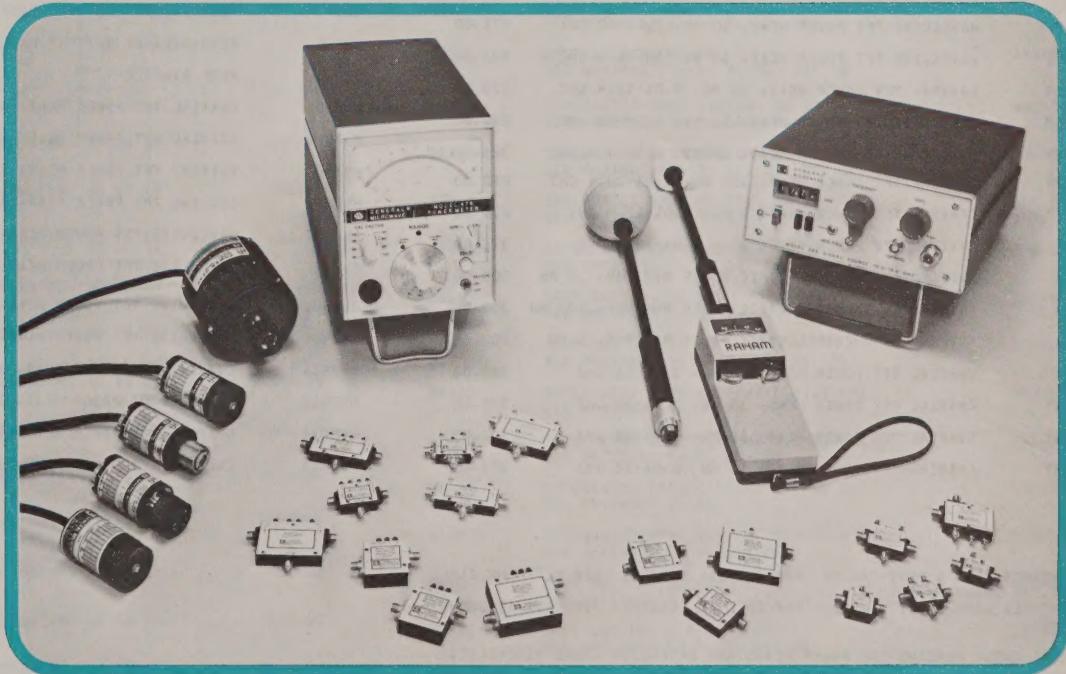




Price List

Oct 76

# General Microwave Corporation



Microwave Instruments and Components

# Power Measuring Equipment



## Price List

MODEL	DESCRIPTION	UNIT PRICE {#}	MODEL	DESCRIPTION	UNIT PRICE {#}
TK-1	TOOL KIT	30.00	M441A <sup>o</sup>	COAXIAL TFT POWER HEAD, 100 MW, 0.01-18 GHZ	300.00
TL-AOA	REPLACEMENT TFT ELEMENT FOR A420C	85.00	M441A <sup>o</sup>	COAXIAL TFT POWER HEAD, 100 MW, 0.01-22 GHZ	325.00
TL-KOA	REPLACEMENT TFT ELEMENT FOR K420C	85.00	N441A <sup>o</sup>	COAXIAL TFT POWER HEAD, 100 MW, 0.01-18 GHZ	300.00
TL-UOA	REPLACEMENT TFT ELEMENT FOR U420C	60.00	P441A <sup>o</sup>	COAXIAL TFT POWER HEAD, 100 MW, 0.01-18 GHZ	375.00
TL-XOA	REPLACEMENT TFT ELEMENT FOR X420C	60.00	460B	THERMOELECTRIC POWER METER	650.00
TL-OA	REPLACEMENT TFT ELEMENT FOR N420C	60.00	468	POWER METER AMPLIFIER	590.00
TL-1A	REPLACEMENT TFT ELEMENT FOR N421D	60.00	471	DIGITAL THERMOELECTRIC POWER METER	1850.00
TL-2A	REPLACEMENT TFT ELEMENT FOR N422C	85.00	476	THERMOELECTRIC POWER METER	750.00
TL-3	REPLACEMENT TFT ELEMENT FOR N423	85.00	963R-4,-6	JUNCTION BOX {CONSULT FACTORY FOR UNIT PRICE}	
TL-4A	REPLACEMENT TFT ELEMENT FOR SERIES 440A AND 4240A UNITS	85.00	W967 <sup>o</sup>	EXTENSION CABLE ASSEMBLY	60.00
TL-5	REPLACEMENT TFT ELEMENT FOR SERIES 441A AND 4240B UNITS	85.00	W970 <sup>o</sup>	EXTENSION CABLE ASSEMBLY	60.00
305B	POWER METER CALIBRATOR	275.00	W972 <sup>o</sup>	EXTENSION CABLE ASSEMBLY	60.00
406A	THERMISTOR DISC ASSEMBLY, 10 MW	25.00	W972-2 <sup>o</sup>	EXTENSION CABLE ASSEMBLY	60.00
408A	BARRETTER ELEMENT, 1 MW	25.00	W972-2 <sup>o</sup>	EXTENSION CABLE ASSEMBLY	60.00
409A	BARRETTER ELEMENT, 10 MW	25.00			
A420C <sup>o</sup>	WAVEGUIDE TFT POWER HEAD, 10 MW, 26.5-40 GHZ	475.00	981	RECHARGEABLE BATTERY PACK FOR 460B	125.00
K420C <sup>o</sup>	WAVEGUIDE TFT POWER HEAD, 10 MW, 18-26.5 GHZ	425.00	981-1	RECHARGEABLE BATTERY PACK FOR 476 {CONSULT FACTORY}	
N420C <sup>o</sup>	COAXIAL TFT POWER HEAD, 10 MW, 0.01-12.4 GHZ	250.00	983-1	RACK ADAPTER	40.00
U420C <sup>o</sup>	WAVEGUIDE TFT POWER HEAD, 10 MW, 12.4-18 GHZ	350.00	M4240A	COAXIAL TFT POWER HEAD, 10 MW, 0.01-18 GHZ	300.00
X420C <sup>o</sup>	WAVEGUIDE TFT POWER HEAD, 10 MW, 8.2-12.4 GHZ	325.00	M4240A	COAXIAL TFT POWER HEAD, 10 MW, 0.01-22 GHZ	325.00
N421D <sup>o</sup>	COAXIAL TFT POWER HEAD, 100 MW, 0.01-12.4 GHZ	250.00	N4240A	COAXIAL TFT POWER HEAD, 10 MW, 0.01-18 GHZ	300.00
N422C <sup>o</sup>	COAXIAL TFT POWER HEAD, 1 MW, 0.01-12.4 GHZ	275.00	P4240A	COAXIAL TFT POWER HEAD, 10 MW, 0.01-18 GHZ	375.00
N423 <sup>o</sup>	COAXIAL TFT POWER HEAD, 3 W, 0.01-12.4 GHZ	375.00	A4240C	WAVEGUIDE TFT POWER HEAD, 10 MW, 26.5-40.0 GHZ	475.00
N425A	INTEGRATED THERMOELECTRIC POWER MONITOR, 10 MW	300.00	K4240C	WAVEGUIDE TFT POWER HEAD, 10 MW, 18.0-26.5 GHZ	425.00
N426A	INTEGRATED THERMOELECTRIC POWER MONITOR, 100 MW	300.00	U4240C	WAVEGUIDE TFT POWER HEAD, 10 MW, 12.4-18 GHZ	350.00
N427A	INTEGRATED THERMOELECTRIC POWER MONITOR, 1 MW	300.00	X4240C	WAVEGUIDE TFT POWER HEAD, 10 MW, 8.2-12.4 GHZ	325.00
M440A <sup>o</sup>	COAXIAL TFT POWER HEAD, 10 MW, 0.01-18 GHZ	300.00	M4241A	COAXIAL TFT POWER HEAD, 100 MW, 0.01-18 GHZ	300.00
M440A <sup>o</sup>	COAXIAL TFT POWER HEAD, 10 MW, 0.01-22 GHZ	325.00	M4241A	COAXIAL TFT POWER HEAD, 100 MW, 0.01-22 GHZ	325.00
N440A <sup>o</sup>	COAXIAL TFT POWER HEAD, 10 MW, 0.01-18 GHZ	300.00	N4241A	COAXIAL TFT POWER HEAD, 100 MW, 0.01-18 GHZ	300.00
P440A <sup>o</sup>	COAXIAL TFT POWER HEAD, 10 MW, 0.01-18 GHZ	375.00	P4241A	COAXIAL TFT POWER HEAD, 100 MW, 0.01-18 GHZ	375.00

<sup>o</sup>FURNISHED WITH 5 FOOT CABLE. FOR SPECIAL LENGTHS, ADD \$25 PLUS CABLE COST, AS SHOWN BELOW:

<sup>o</sup>oFURNISHED WITH 6 FOOT CABLE. FOR SPECIAL LENGTHS, ADD COST AS SHOWN BELOW:

SPECIAL CABLE LENGTHS FOR POWER HEADS AND EXTENSION CABLE ASSEMBLIES

LESS THAN 25 FEET ADDITIONAL	\$1/FT
25-50 FEET ADDITIONAL	.80/FT
51-100 FEET ADDITIONAL	.60/FT
100+ FEET ADDITIONAL	.50/FT

### GENERAL MICROWAVE CORPORATION

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# PIN Diode Control Devices



## Price List

MODEL	DESCRIPTION	UNIT PRICE (\$)	MODEL	DESCRIPTION	UNIT PRICE (\$)
DM186BH	ABSORPTIVE HIGH SPEED SPST SWITCH, 35 DB SEE OPTIONS: 7, 9, 10, 20, 30, 31	410.00	325-120-6, 325L-120-6	PROGRAMMABLE STEP ATTENUATOR, 120 DB IN 6 DB STEPS	1880.00
LM186B	ABSORPTIVE ATTENUATOR, 45 DB SEE OPTIONS: 4, 7, 10, 33, 35	270.00	325-120-10, 325L-120-10	PROGRAMMABLE STEP ATTENUATOR, 120 DB IN 10 DB STEPS	1635.00
M186B	ABSORPTIVE ATTENUATOR, 45 DB SEE OPTIONS: 4, 7, 10, 33, 35	270.00	DM862A	INTEGRATED SPST SWITCH, 40 DB SEE OPTIONS: 7, 9, 10, 20, 30	200.00
DM189H	ABSORPTIVE HIGH SPEED SPST SWITCH, 65 DB SEE OPTIONS: 7, 9, 10, 20, 30, 31	720.00	DM862AH	INTEGRATED SPST SWITCH, 40 DB SEE OPTIONS: 7, 9, 10, 20, 25, 30	200.00
LM189	ABSORPTIVE ATTENUATOR, 65 DB SEE OPTIONS: 4, 7, 10, 33, 35	490.00	FM862A	INTEGRATED SPST SWITCH, 40 DB SEE OPTIONS: 7, 9, 10, 10	200.00
M189	ABSORPTIVE ATTENUATOR, 65 DB SEE OPTIONS: 4, 7, 10, 33, 35	490.00	FM862AH	INTEGRATED SPST SWITCH, 40 DB SEE OPTIONS: 7, 9, 10, 25	200.00
DM190H	ABSORPTIVE HIGH SPEED SPST SWITCH, 45 DB SEE OPTIONS: 7, 9, 10, 20, 30, 31	410.00	M862A	SPST SWITCH, 40 DB SEE OPTIONS: 3, 4, 7, 10, 33	125.00
LM190	ABSORPTIVE ATTENUATOR, 35 DB SEE OPTIONS: 4, 7, 10, 33, 35	270.00	M862AH	SPST SWITCH, 40 DB SEE OPTIONS: 3, 4, 7, 10, 25, 33	125.00
M190	ABSORPTIVE ATTENUATOR, 35 DB SEE OPTIONS: 4, 7, 10, 33, 35	270.00	DM863	INTEGRATED SPST SWITCH, 60 DB SEE OPTIONS: 7, 9, 10, 20, 30	220.00
311	LOGARITHMIC DRIVER FOR M186B, LM186B, M190 AND LM190 {1 EACH}, AND M189 AND LM189 {2 EACH}	145.00	DM863H	INTEGRATED SPST SWITCH, 60 DB SEE OPTIONS: 7, 9, 10, 20, 25, 30	220.00
312A	ON-OFF SWITCH DRIVER FOR M186B, LM186B, M190 AND LM190 {1 EACH}, AND M189 AND LM189 {2 EACH}	75.00	FM863	INTEGRATED SPST SWITCH, 60 DB SEE OPTIONS: 7, 9, 10	220.00
314A	DRIVER FOR SWITCHES AS FOLLOWS:	55.00	FM863H	INTEGRATED SPST SWITCH, 60 DB SEE OPTIONS: 7, 9, 10, 25	220.00
	UNIT	QTY REQUIRED			
	M862A, M862AH	1	M863	SPST SWITCH, 60 DB SEE OPTIONS: 3, 4, 7, 10, 33	145.00
	M863, M863H	1	M863H	SPST SWITCH, 60 DB SEE OPTIONS: 3, 4, 7, 10, 25, 33	145.00
	M864, M864H	1	DM864	INTEGRATED SPST SWITCH, 80 DB SEE OPTIONS: 7, 9, 10, 20, 30	240.00
	M870	2	DM864H	INTEGRATED SPST SWITCH, 80 DB SEE OPTIONS: 7, 9, 10, 20, 25, 30	240.00
	M875	3	FM864	INTEGRATED SPST SWITCH, 80 DB SEE OPTIONS: 7, 9, 10, 10	240.00
	M871	4	FM864H	INTEGRATED SPST SWITCH, 80 DB SEE OPTIONS: 7, 9, 10, 25	240.00
	M873	5			
325-10-1, 325L-10-1	PROGRAMMABLE STEP ATTENUATOR, 10 DB IN 1 DB STEPS	680.00	M864	SPST SWITCH, 80 DB SEE OPTIONS: 3, 4, 7, 10, 33	165.00
325-20-1, 325L-20-1	PROGRAMMABLE STEP ATTENUATOR, 20 DB IN 1 DB STEPS	925.00	M864H	SPST SWITCH, 80 DB SEE OPTIONS: 3, 4, 7, 10, 25, 33	165.00
325-20-2, 325L-20-2	PROGRAMMABLE STEP ATTENUATOR, 20 DB IN 2 DB STEPS	680.00	DM864	INTEGRATED SPST SWITCH, 80 DB SEE OPTIONS: 7, 9, 10, 25	240.00
325-30-1, 325L-30-1	PROGRAMMABLE STEP ATTENUATOR, 30 DB IN 1 DB STEPS	1170.00	M864	SPST SWITCH, 80 DB SEE OPTIONS: 3, 4, 7, 10, 33	165.00
325-30-10, 325L-30-10	PROGRAMMABLE STEP ATTENUATOR, 30 DB IN 10 DB STEPS	680.00	M864H	SPST SWITCH, 80 DB SEE OPTIONS: 3, 4, 7, 10, 25, 33	165.00
325-40-1, 325L-40-1	PROGRAMMABLE STEP ATTENUATOR, 40 DB IN 1 DB STEPS	1145.00	DM870	INTEGRATED SPST SWITCH, 0.2-18 GHZ SEE OPTIONS: 4, 7, 20, 22	460.00
325-40-2, 325L-40-2	PROGRAMMABLE STEP ATTENUATOR, 40 DB IN 2 DB STEPS	1145.00	ADM870	INTEGRATED SPST SWITCH, 0.2-12.4 GHZ SEE OPTIONS: 4, 7, 20, 22	445.00
325-40-10, 325L-40-10	PROGRAMMABLE STEP ATTENUATOR, 40 DB IN 10 DB STEPS	900.00	FM870	INTEGRATED SPST SWITCH, 0.2-18 GHZ SEE OPTIONS: 7, 35	440.00
325-60-1, 325L-60-1	PROGRAMMABLE STEP ATTENUATOR, 60 DB IN 1 DB STEPS	1390.00	AFM870	INTEGRATED SPST SWITCH, 0.2-12.4 GHZ SEE OPTIONS: 4, 7, 20, 22	425.00
325-60-6, 325L-60-6	PROGRAMMABLE STEP ATTENUATOR, 60 DB IN 6 DB STEPS	900.00	M870	SPST SWITCH, 0.2-18 GHZ SEE OPTIONS: 3, 4, 7, 33, 35	325.00
325-60-10, 325L-60-10	PROGRAMMABLE STEP ATTENUATOR, 60 DB IN 10 DB STEPS	900.00	AM870	SPST SWITCH, 0.2-12.4 GHZ SEE OPTIONS: 3, 4, 7, 33, 35	310.00
325-80-1, 325L-80-1	PROGRAMMABLE STEP ATTENUATOR, 80 DB IN 1 DB STEPS	1660.00	DM871	INTEGRATED SP4T SWITCH, 0.2-18 GHZ SEE OPTIONS: 4, 7, 9, 20	750.00
325-80-2, 325L-80-2	PROGRAMMABLE STEP ATTENUATOR, 80 DB IN 2 DB STEPS	1435.00	ADM871	INTEGRATED SP4T SWITCH, 0.2-12.4 GHZ SEE OPTIONS: 4, 7, 9, 20	725.00
325-100-2, 325L-100-2	PROGRAMMABLE STEP ATTENUATOR, 100 DB IN 2 DB STEPS	1880.00			

GENERAL MICROWAVE CORPORATION

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# PIN Diode Control Devices



## Price List

MODEL	DESCRIPTION	UNIT PRICE (\$*)	MODEL	DESCRIPTION	UNIT PRICE (\$*)
FM871	INTEGRATED SP4T SWITCH, 0.2-18 GHZ SEE OPTIONS: 7, 35	695.00	9113	MINIATURE SPST SWITCH, 60 dB, 2-18 GHz SEE OPTIONS: 3, 4, 7, 10, 33	145.00
AFM871	INTEGRATED SP4T SWITCH, 0.2-12.4 GHZ SEE OPTIONS: 7, 35	670.00	F9113	INTEGRATED MINIATURE SPST SWITCH, 60 dB, 2-18 GHz SEE OPTIONS: 7, 9, 10, 33	210.00
M871	SP4T SWITCH, 0.2-18 GHZ SEE OPTIONS: 3, 4, 7, 33, 35	500.00	9114	MINIATURE SPST SWITCH, 80 dB, 2-18 GHz SEE OPTIONS: 3, 4, 7, 10, 33	165.00
AM871	SP4T SWITCH, 0.2-12.4 GHZ SEE OPTIONS: 3, 4, 7, 33, 35	475.00	F9114	INTEGRATED MINIATURE SPST SWITCH, 80 dB, 2-18 GHz SEE OPTIONS: 7, 9, 10, 33	230.00
FM873	INTEGRATED SPST SWITCH, 0.2-18 GHz SEE OPTIONS: 7, 35	865.00	9120°	MINIATURE SP2T SWITCH, 2018 GHz SEE OPTIONS: 3, 4, 7, 33	195.00
AFM873	INTEGRATED SPST SWITCH, 0.2-12.4 GHz SEE OPTIONS: 7, 35	840.00	F9120°	INTEGRATED MINIATURE SP2T SWITCH, 2-18 GHz SEE OPTIONS: 3, 4, 7, 9, 27, 33	275.00
M873	SPST SWITCH, 0.2-18 GHz SEE OPTIONS: 3, 4, 7, 33, 35	625.00	F9121°	INTEGRATED MINIATURE SP2T SWITCH, 2-18 GHz SEE OPTIONS: 3, 4, 7, 9, 27, 33	275.00
AM873	SPST SWITCH, 0.2-12.4 GHz SEE OPTIONS: 3, 4, 7, 33, 35	600.00	9130°	MINIATURE SP3T SWITCH, 2-18 GHz SEE OPTIONS: 3, 4, 7, 33	250.00
FM875	INTEGRATED SP3T SWITCH, 0.2-18 GHz SEE OPTIONS: 7, 35	600.00	F9130°	INTEGRATED MINIATURE SP3T SWITCH, 2-18 GHz SEE OPTIONS: 3, 4, 7, 9, 33	370.00
AFM875	INTEGRATED SP3T SWITCH, 0.2-12.4 GHz SEE OPTIONS: 7, 35	575.00	9140°	MINIATURE SP4T SWITCH, 2-18 GHz SEE OPTIONS: 3, 4, 7, 33	325.00
M875	SP3T SWITCH, 0.2-18 GHz SEE OPTIONS: 3, 4, 7, 33, 35	425.00	F9140°	INTEGRATED MINIATURE SP4T SWITCH, 2-18 GHz SEE OPTIONS: 3, 4, 7, 9, 33	450.00
AM875	SP3T SWITCH, 0.2-12.4 GHz SEE OPTIONS: 3, 4, 7, 33, 35	405.00	9150°	MINIATURE SP5T SWITCH, 2-18 GHz SEE OPTIONS: 3, 4, 7, 33	375.00
1951	ABSORPTIVE MODULATOR, L BAND SEE OPTIONS: 3, 7, 10, 64	250.00	F9150°	INTEGRATED MINIATURE SP5T SWITCH, 2-18 GHz SEE OPTIONS: 3, 4, 7, 9, 33	535.00
D1951	INTEGRATED ABSORPTIVE MODULATOR, L BAND SEE OPTIONS: 7, 10, 61, 62	425.00	9160°	MINIATURE SP6T SWITCH, 2-18 GHz SEE OPTIONS: 3, 4, 7, 33	425.00
1952	ABSORPTIVE MODULATOR, S BAND SEE OPTIONS: 3, 7, 10, 64	250.00	F9160°	INTEGRATED MINIATURE SP6T SWITCH, 2-18 GHz SEE OPTIONS: 3, 4, 7, 9, 33	635.00
D1952	INTEGRATED ABSORPTIVE MODULATOR, S BAND SEE OPTIONS: 7, 10, 61, 62	425.00	9214	MINIATURE SPST SWITCH, 80 dB, 0.2-4.0 GHz SEE OPTIONS: 3, 4, 7, 10, 33	365.00
1954	ABSORPTIVE MODULATOR, C BAND SEE OPTIONS: 3, 7, 10, 64	250.00	F9214	INTEGRATED MINIATURE SPST SWITCH, 80 dB, 0.2-4.0 GHz SEE OPTIONS: 7, 9, 10, 33	230.00
D1954	INTEGRATED ABSORPTIVE MODULATOR, C BAND SEE OPTIONS: 7, 10, 61, 62	425.00	9220°	MINIATURE SP2T SWITCH, 0.2-4.0 GHz SEE OPTIONS: 3, 4, 7, 33	375.00
1958	ABSORPTIVE MODULATOR, X-U BAND SEE OPTIONS: 3, 7, 10, 64	250.00	F9220°	INTEGRATED MINIATURE SP2T SWITCH, 0.2-4.0 GHz SEE OPTIONS: 3, 4, 7, 9, 27, 33	275.00
D1958	INTEGRATED ABSORPTIVE MODULATOR, X-U BAND SEE OPTIONS: 7, 10, 61, 62	425.00	F9221°	INTEGRATED MINIATURE SP2T SWITCH, 0.2-4.0 GHz SEE OPTIONS: 3, 4, 7, 9, 27, 33	275.00
8922	HIGH SPEED SP2T SWITCH, S BAND SEE OPTIONS: 7A, 7B, 64	185.00	9230°	MINIATURE SP3T SWITCH, 0.2-4.0 GHz SEE OPTIONS: 3, 4, 7, 33	250.00
F8922	INTEGRATED HIGH SPEED SP2T SWITCH, S BAND SEE OPTIONS: 7A, 7B, 9, 27, 64	235.00	F9230°	INTEGRATED MINIATURE SP3T SWITCH, 0.2-4.0 GHz SEE OPTIONS: 3, 4, 7, 9, 33	370.00
8924	HIGH SPEED SP2T SWITCH, C BAND SEE OPTIONS: 7A, 7B, 64	185.00	9240°	MINIATURE SP4T SWITCH, 0.2-4.0 GHz SEE OPTIONS: 3, 4, 7, 33	325.00
F8924	INTEGRATED HIGH SPEED SP2T SWITCH, C BAND SEE OPTIONS: 7A, 7B, 9, 27, 64	235.00	F9240°	INTEGRATED MINIATURE SP4T SWITCH, 0.2-4.0 GHz SEE OPTIONS: 3, 4, 7, 9, 33	450.00
8928	HIGH SPEED SP2T SWITCH, X-U BAND SEE OPTIONS: 7A, 7B, 64	185.00	9250°	MINIATURE SP5T SWITCH, 0.2-4.0 GHz SEE OPTIONS: 3, 4, 7, 33	375.00
F8928	INTEGRATED HIGH SPEED SP2T SWITCH, X-U BAND SEE OPTIONS: 7A, 7B, 9, 27, 64	235.00	F9250°	INTEGRATED MINIATURE SP5T SWITCH, 0.2-4.0 GHz SEE OPTIONS: 3, 4, 7, 9, 33	535.00
9112	MINIATURE SPST SWITCH, 45 dB, 2-18 GHz SEE OPTIONS: 3, 4, 7, 10, 33	125.00	9260°	MINIATURE SP6T SWITCH, 0.2-4.0 GHz SEE OPTIONS: 3, 4, 7, 33	425.00
F9112	INTEGRATED MINIATURE SPST SWITCH, 45 dB, 2-18 GHz SEE OPTIONS: 7, 9, 10, 33	190.00	F9260°	INTEGRATED MINIATURE SP6T SWITCH, 0.2-4.0 GHz SEE OPTIONS: 3, 4, 7, 9, 33	615.00

\*FOR TERMINATED VERSIONS, ADD SUFFIX "T". SURCHARGE - \$20/OUTPUT PORT

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# PIN Diode Control Devices



## Price List

OPTIONS		
OPTION NO.	DESCRIPTION	UNIT PRICE (\$)
3	SMA FEMALE BIAS CONNECTOR(S) (FOR SWITCHES ONLY)	
	SPST	5.00
	SP2T	10.00
	SP3T	15.00
	SP4T	20.00
	SP5T	25.00
	SP6T	30.00
4	SOLDER TYPE BIAS TERMINAL(S)	N/C
7	SMA MALE RF CONNECTOR(S) (FOR SWITCHES AND ATTENUATORS)	
	SPST	15.00
	SP2T	20.00
	SP3T	25.00
	SP4T	30.00
	SP5T	35.00
	SP6T	40.00
7A	SMA MALE (COMMON), TWO SMA FEMALE (OUTPUT) RF CONNECTORS	10.00
7B	SMA FEMALE (COMMON), TWO SMA MALE (OUTPUT) RF CONNECTORS	15.00
9	INVERSE LOGIC	N/C
10	ONE SMA MALE, ONE SMA FEMALE RF CONNECTORS	10.00
20	TWO-UNIT LOAD TTL CONTROL INPUT IMPEDANCE	N/C
22	INDIVIDUAL PORT CONTROL	25.00
25	20 NSEC, 0.1-18 GHZ DESIGN	N/C
27	ONE PORT TOGGLE	N/C
30	SOLDER-TYPE CONTROL TERMINAL	N/C
31	HIGH ISOLATION (REFLECTIVE) DESIGN	N/C
33	EMI FILTER BIAS/LGC TERMINALS	
	M186B, LM186B	20.00
	M189, LM189	40.00
	M190, LM190	20.00
	M862A, M862AH	15.00
	M863, M863H	15.00
	M864, M864H	15.00
	M870, AN870	20.00
	M871, AN871	40.00
	M873, AN873	50.00
	M875, AN875	30.00
	9112, 9113	15.00
	9114, 9214	15.00
	F9112, F9113	15.00
	F9114, F9214	15.00
	9120, 9220	20.00
	9130, 9230	30.00
	F9120, F9220, F9121, F9221	20.00
	F9130, F9230	30.00
	F9140, F9240	40.00
	F9150, F9250	50.00
	F9160, F9260	60.00
35	HIGH TEMPERATURE DESIGN (+110 DEG C)	
	FM870, AFM870	10.00
	FM872, AFM872	20.00
	FM873, AFM873	25.00
	FM875, AFM875	15.00
	HIGH TEMPERATURE DESIGN (+125 DEG C)	
	M186B, LM186B	15.00
	M189, LM189	30.00
	M190, LM190	15.00
	M870, AN870	10.00
	M871, AN871	20.00
	M873, AN873	25.00
	M875, AN875	15.00
61	20 DB/VOLT TRANSFER FUNCTION WITH 0 TO +3V CONTROL INPUT SIGNAL	N/C
62	$\pm 15$ VOLTS OPERATION	10.00
64	SMC BIAS/CONTROL CONNECTOR	15.00

GENERAL MICROWAVE CORPORATION

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# RAHAM™ Radiation Hazard Meters

## Price List



MODEL	DESCRIPTION	UNIT PRICE (\$)
1	RADIATION HAZARD METER, 0.3-18 GHZ	475.00
2	RADIATION HAZARD METER, 0.01-3 GHZ	275.00
3	RADIATION HAZARD METER, ISOTROPIC, 0.3-18 GHZ	750.00
12	RADIATION HAZARD METER, 0.01-18 GHZ	625.00
81	PROBE, 0.3-18 GHZ	350.00
82	PROBE, 0.01-3 GHZ	150.00
83	PROBE, ISOTROPIC, 0.3-18 GHZ	625.00
481A	POWER DENSITY METER	125.00

GENERAL MICROWAVE CORPORATION

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# Solid State Microwave Signal Sources



## Price List

MODEL	DESCRIPTION	UNIT PRICE {\$}
S20	SIGNAL SOURCE, 0.4 TO 1.2 GHZ	1750.00
S21	SIGNAL SOURCE, 0.85 TO 2.15 GHZ	1750.00
S22	SIGNAL SOURCE, 2.0 TO 4.0 GHZ	2300.00
S23	SIGNAL SOURCE, 4.0 TO 8.0 GHZ	2300.00
S23-1	SIGNAL SOURCE, 4.5 TO 8.5 GHZ	2300.00
S24	SIGNAL SOURCE, 8.0 TO 12.5 GHZ	2300.00
S25	SIGNAL SOURCE, 12.0 TO 18.0 GHZ	2500.00
<u>SOLID-STATE COAXIAL NOISE SOURCES</u>		
NS10-1	NOISE GENERATOR, 0.01 TO 1.5 GHZ, 30 DB ENR	645.00
MS10-1P NS10-1P	NOISE GENERATOR, 0.01 TO 1.5 GHZ, 15 DB ENR	760.00
MS10-2 NS10-2	NOISE GENERATOR, 1.0 TO 2.0 GHZ, 30 DB ENR	620.00
MS10-2P NS10-2P	NOISE GENERATOR, 1.0 TO 2.0 GHZ, 15 DB ENR	760.00
MS10-3 NS10-3	NOISE GENERATOR, 2.0 TO 4.0 GHZ, 30 DB ENR	620.00
MS10-3P NS10-3P	NOISE GENERATOR, 2.0 TO 4.0 GHZ, 15 DB ENR	760.00
MS10-4 NS10-4	NOISE GENERATOR, 4.0 TO 8.0 GHZ, 30 DB ENR	620.00
MS10-4P NS10-4P	NOISE GENERATOR, 4.0 TO 8.0 GHZ, 15 DB ENR	760.00
MS10-5 NS10-5	NOISE GENERATOR, 8.0 TO 12.4 GHZ, 30 DB ENR	620.00
MS10-5P NS10-5P	NOISE GENERATOR, 8.0 TO 12.4 GHZ, 15 DB ENR	760.00
MS10-6P NS10-6P	NOISE GENERATOR, 1.0 TO 12.4 GHZ, 15 DB ENR	1295.00
MS10-7	NOISE GENERATOR, 12.4 TO 18.0 GHZ, 30 DB ENR	705.00
MS10-7P	NOISE GENERATOR, 12.4 TO 18.0 GHZ, 15 DB ENR	760.00

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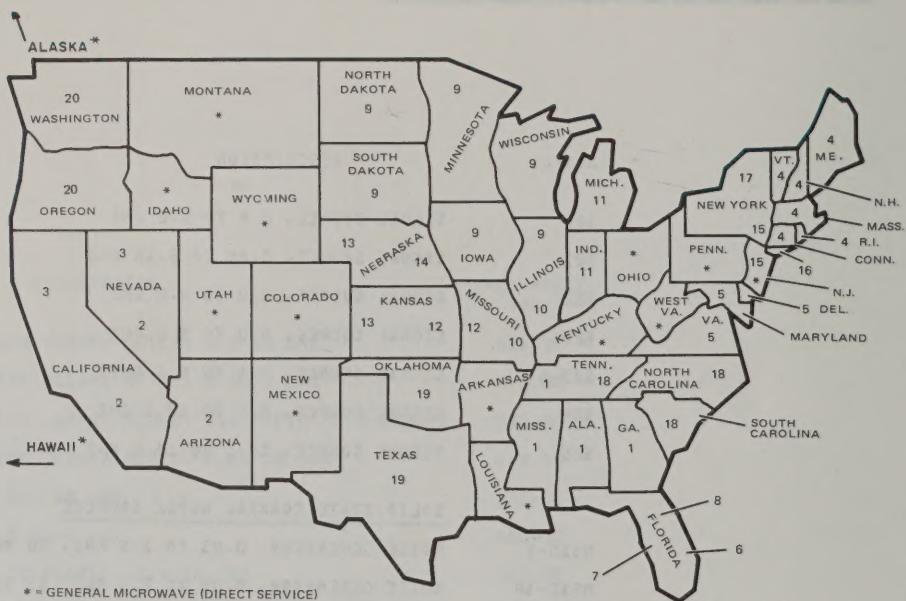
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# Microwave Instruments and Components

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# Microwave Instruments and Components

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# Power Measuring Equipment

In 1964, General Microwave achieved a breakthrough in the field of power measuring equipment when it developed the thermoelectric technique of rf and microwave power measurement. This technique employs **tft**® (thin-film thermoelectric) power heads, which produce dc output voltages directly proportional to the absorbed power.

Since then, power measuring products designed and produced by GMC have become the standard of performance, user convenience and best-buy value—service-proved in a wide range of military, industrial and commercial applications.

## SELECTION GUIDE

Product	Description	Page No.
POWER METER Model 476	55 dB dynamic range. Analog readout, internal calibrator, automatic zero-set, built-in calibration factor compensator, DVM/recorder output.	4
POWER METER Model 460B	45 dB dynamic range. Analog readout, direct-reading, automatic scale selection, DVM/recorder output.	8
POWER METER Model 471	50 dB dynamic range. Digital readout in dBm or watts, automatic range and scale selection, automatic zero-set, remotely programmable, over and under-range indicators, tuning meter, analog and digital outputs, DVM/recorder output.	10
POWER METER AMPLIFIER Model 468	40 dB dynamic range. Chopper-stabilized dc amplifier (no readout meter) for systems applications.	12
POWER HEADS ① Series 4200	Up to 100 mW. Waveguide and miniature coaxial types (with SMA, N or APC-7 input connectors).	6
POWER HEADS ② Series 44A and 420	Up to 3 W. Waveguide, coaxial and miniature coaxial types (with SMA, N or APC-7 input connectors). Includes self-contained efficiency compensator.	14
POWER MONITORS Models N425A, N426A, N427A	Up to 100 mW. Includes tft power sensor and dc amplifier in single compact package, for local or remote power monitoring.	16
ACCESSORIES	Junction Boxes, Calibrator, Tool Kit, Rack Adapter, Special Cables, Battery Packs.	18-20

① For use with Model 476 Power Meter.

② For use with Models 460B and 471 Power Meters and Model 468 Amplifier.



Power Measuring Equipment

# Thermoelectric Power Meter

## Model 476



- **0.01 to 40 GHz frequency range**
- **30 nanowatts to 100 mW power range**
- **±1% of full scale accuracy**
- **<1.5% noise and drift**
- **Internal calibrator**
- **Automatic zero set**
- **Built-in calibration factor compensator**
- **Optional rechargeable battery pack**

The Model 476 is a third-generation equipment, employing the service-proved thermoelectric technique of rf and microwave power measurement pioneered by General Microwave more than a decade ago.

This model incorporates a number of features that enhance accuracy, dynamic range and convenience of operation. Prominent among these is a self-calibration capability employing a highly stable 10 kHz oscillator which assures that the power meter gain is matched to the sensitivity of the power head in use. Calibration of the power meter-power head assemblage is conveniently checked and adjusted at the meter's front panel without disconnecting the power head from the rf system under measurement. This is particularly useful in applications where the power head is remote from the power meter, or in systems where access to the power head is inconvenient.

Another feature of the Model 476 is automatic zero set which can be activated on any range by means of a front panel push-button. In addition, the unit provides automatic scale indication when changing from power heads of one dynamic range to another.

The Model 476 is packaged in the third-rack configuration convenient for bench use or rack mounting. For portable and field applications, an optional rechargeable battery pack is available.

### tft™ Power Heads

The Model 476 is designed to operate with the Series 4200 coaxial and waveguide power heads. The power range of the meter is dependent on the power head used, as follows:

POWER HEAD MODEL	MODEL 476 POWER RANGE	
	From	To
M4240A, N4240A, P4240A (coaxial) X4240C, U4240C, K4240C, A4240C (waveguide)	30 nW (-45 dBm)	10 mW (+10 dBm)
M4241A, N4241A, P4241A (coaxial)	300 nW (-35 dBm)	100 mW (+20 dBm)

For complete description of these power heads, see pages 6-7.

## Specifications, Model 476

Instrument Type .....	Thermoelectric power meter, for use with General Microwave Series 4200 coaxial and waveguide power heads.
Power Range .....	From 30 nW to 100 mW (−45 dBm to +20 dBm). Twelve full-scale readings: 0.3, 1, 3, 10, 30 and 100 $\mu$ W; 0.3, 1, 3, 10, 30 and 100 mW.
Accuracy .....	$\pm 1\%$ of full scale on all ranges, from 0°C to +55°C.
Noise and Drift .....	Less than 1.5% peak on most sensitive range; proportionately less on less sensitive ranges.
Self Calibration .....	Self contained 10 kHz oscillator. (Accuracy $\pm 0.3\%$ @ 25°C)
Zero Set .....	Automatic on all ranges, operated by front-panel button.
rf Disable .....	Provides ground closure at rear connector in auto-zero and calibration modes.
Scale Selection .....	Automatic indicator corresponding to power head in use.
Power Head Calibration Factor Compensator .....	Continuously variable front-panel control; range is 86 to 100%.
Response Time (Time Constant) ....	Less than 0.5 second for seven upper ranges; less than 1.5 seconds for three most sensitive ranges.
DVM/Recorder Output .....	Rear mounted connector provides output proportional to indicated power with −1.0 volt corresponding to full scale; minimum load resistance of 1000 ohms.
Input Power .....	115/230V $\pm 10\%$ , 50-1000 Hz, 5 watts.
Input Connector .....	Front panel mounted. (Optional rear panel location).
Meter .....	4½", mirror scales, taut-band suspension.
Dimensions .....	6.1" H x 5.1" W x 11" D (155 x 130 x 279 mm).
Approximate Weight .....	7 lbs. (3.2 kg.).



## Power Measuring Equipment

# tft® Power Heads, Miniature Coaxial and Waveguide

## Series 4200

(For use with Model 476 Power Meter)



- **0.01 to 40 GHz frequency range**
- **Type SMA, N, or APC-7 coaxial connectors**
- **Field-replaceable elements**
- **Up to 300% overload protection**
- **Individually calibrated against NBS-certified standards**
- **Can be operated at distances up to several hundred feet from the power meter**

Series 4200 **tft** Power Heads\* employ the well-established thermoelectric technique of rf and microwave power measurement pioneered by General Microwave more than a decade ago. Designed for use with the Model 476 power meter, the Series 4200 includes four waveguide models with a power range of 10mW full scale, plus six coaxial units in two power ranges (10 and 100mW). The coaxial units are available with type SMA, N or APC-7 input connectors.

The power head design uses thin-film metallic loads to absorb incident rf power. By constructing the rf load as a bi-metallic element, vacuum-deposited on a thin dielectric substrate, pairs of thermoelectric junctions are created. Half of the junctions are thermally "sunked" to the transmission line conductors, while the others are located within the air space between. These latter junctions constitute almost the entire calorimetric mass, enabling high sensitivity and fast response time.

The absorption of rf power by the load creates a temperature difference between the hot and cold junctions that gives rise to a thermoelectric emf. By keeping this temperature differential small, the load acts as a true square-law (rms) device, producing a dc output voltage directly proportional to the absorbed power.

Since the element within the power head responds only to the rms value of the input power, it is completely insensitive to waveshape. Pulsed, amplitude-modulated and cw signals are measured with equal accuracy. Overload input levels up to 300% of the maximum rated power are safely handled. Long term stability is insured by stringent inspection and aging procedures. In the event that replacement of the element becomes necessary, it can be readily performed at the user's facilities.

All units are individually calibrated against NBS-certified standards for calibration factor vs. frequency. Compensation for calibration factor is accomplished by means of a calibrated control located on the front panel of the Model 476 power meter. The power heads are normally supplied with a five-foot umbilical cable. Special length cables or General Microwave extension cables (see page 20) can be provided where greater separation between the power head and power meter is required. The power head and meter will operate satisfactorily even when separated from each other by hundreds of feet.

## Specifications, Series 4200

MODEL NO.	COAXIAL TYPES						WAVEGUIDE TYPES			
	M4240A	N4240A	P4240A	M4241A	N4241A	P4241A	X4240C	U4240C	K4240C	A4240C
Input Connector Type	SMA-Male	N-Male	APC-7	SMA-Male	N-Male	APC-7	UG-39/U	UG-419/U	UG-595/U	UG-599/U
Transmission Line	Coaxial			Coaxial			RG-52/U	RG-91/U	RG-53/U	RG-96/U
Frequency Range (GHz)	0.01-22①	0.01-18	0.01-18	0.01-22①	0.01-18	0.01-18	8.2-12.4	12.4-18.0	18.0-26.5	26.5-40.0
Maximum Average Power	10 mW (+10 dBm)			100 mW (+20 dBm)			10 mW (+10 dBm)			
Overload Rating ②	300%			200%			300%		300%	
Max. Pulse Energy at +25°C (W-μsec)	5			30			10		5	
Max. Pulse Power at +25°C (W)	1			15			2		1	
Max. Pulse Duration ⑥ at +25°C (μsec)	5			2			5		5	
Field-Replaceable Elements	TL-4A			TL-5			TL-X0-A	TL-U0-A	TL-K0-A	TL-A0-A
Max. VSWR	1.35③			1.35③			1.5	1.5	1.5	1.65
Element Temperature Sensitivity	0.1%/°C			0.1%/°C			0.1%/°C			
Diameter	⑤ 1.29" (33mm)	⑤ 1.29" (33mm)	⑤ 1.29" (33mm)	⑤ 1.29" (33mm)	⑤ 1.29" (33mm)	⑤ 1.29" (33mm)	④ 2.12" (54mm)			
Length	2.50" (67mm)	3.00" (76mm)	3.07" (78mm)	2.50" (67mm)	3.00" (76mm)	3.07" (78mm)	3.74" (95mm)			
Weight, approx.	3 oz. (85gm)			3 oz. (85gm)			32 oz. (850gm)			

① For Models M4240A and M4241A, the upper frequency limit on standard units is 18 GHz; operation to 22 GHz is available on special order.

② While the heads will take overloads for short periods of time, extended periods of operation at overload levels may result in permanent change in the element characteristics or even burnout. Maximum care should be exercised to avoid such an occurrence.

③ Except in the range from .010 to .015 GHz where VSWR may rise to 1.5, and from 10 GHz to upper limit where VSWR may rise to 1.6.

④ Maximum, excluding rf connector, cable and multi-pin connector.

⑤ Maximum, including rf connector but excluding cable and multi-pin connector.

⑥ At maximum pulse power.



Power Measuring Equipment

# Thermoelectric Power Meter

## Model 460B



- **30 nanowatts to 3 watts direct-reading**
- **0.01 to 40 GHz frequency range**
- **±1% of full scale accuracy**
- **<±1% peak-to-peak noise and drift**
- **Automatic scale selection**
- **DVM/recorder output**
- **Optional rechargeable battery pack**

The Model 460B, in conjunction with Series 420 and Series 44A **tft** power heads, measures modulated, pulsed and cw signals over a wide frequency and power range. The power meter has a full 45 dBm power scale range for direct-reading power measurements from 30 nanowatts to 3 watts over a frequency range from 0.01 to 40 GHz, dependent on the power head in use—with an accuracy of ±1% of full scale. Although fifteen different ranges in four overlapping scales are provided, a novel technique of automatic scale selection and display simplifies its operation. Only that scale corresponding to the sensitivity of the power head in use is activated, and only the selected range is illuminated.

Short-term noise and drift is limited to less than ±1% peak-to-peak on the most sensitive range by a unique chopper-stabilized dc amplifier with high gain stability.

The Model 460B is equipped with an output jack for measurement systems using external recorders or digital voltmeters. The voltage output is a dc analog of the measured rf power and is adjustable from 0 to —1 volt full scale. Two additional features are: a rear-panel switch which enables the operator to select either NORMAL or FAST amplifier response time and two paralleled input connectors—one on the front panel and one on the rear.

For portable and field applications, an optional rechargeable battery pack is available. The Model 460B is packaged in the half-rack configuration, convenient for bench use or rack mounting.

### **tft® Power Heads**

A full line of thin-film thermoelectric waveguide and coaxial power heads is available for operation with the Model 460B. The power range of the meter is dependent on the power head used, as follows:

POWER HEAD MODEL	MODEL 460B POWER RANGE	
	From	To
N422C (coaxial)	0.03 $\mu$ W (—45 dBm)	1 mW (0 dBm)
N420C, M440A, N440A, P440A (coaxial) X420C, U420C, K420C, A420C (waveguide)	0.3 $\mu$ W (—35 dBm)	10 mW (+10 dBm)
N421D, M441A, N441A, P441A (coaxial)	3.0 $\mu$ W (—25 dBm)	100 mW (+20 dBm)
N423 (coaxial)	0.3 mW (—5 dBm)	3 W (+35 dBm)

For complete description of these power heads, see pages 14-15.

## Specifications, Model 460B

Instrument Type .....	Thermoelectric power meter for use with General Microwave Series 420 and 44A coaxial and waveguide power heads.
Power Range .....	From 30 nanowatts to 3 watts (-45 dBm to +35 dBm). Fifteen different ranges in four overlapping power scales, with full-scale readings of 0.3, 1, 3, 10, 30, 100 and 300 $\mu$ W; 1, 3, 10, 30, 100 and 300 mW; 1 and 3W.
Frequency Range .....	0.01 to 40 GHz, with appropriate power heads.
Accuracy .....	$\pm 1\%$ of full scale on all ranges, from 0°C to +55°C.
Noise and Drift .....	$< \pm 0.5\%$ peak-to-peak of full scale on the lowest ranges ( $< \pm 1\%$ peak-to-peak on high sensitivity scale) at constant ambient; correspondingly less on higher ranges.
DVM/Recorder Output .....	Two outputs available: Calibrated analog output; -1V dc full scale for DVM use. Adjustable dc output; 0 to -1V full scale for recorder use.
Response Time .....	NORMAL position, less than 1.5 sec.; FAST position approximately 100 msec.
Input Power .....	115/230V $\pm 10\%$ , 50-1000 Hz, 5W.
Input Connectors .....	Two provided, one on front panel and one on rear.
Zero Carryover .....	One-time zero set, holds for all ranges.
Meter .....	4 1/2", mirror scales, taut-band suspension.
Dimensions (max) .....	6.75" H x 7.8" W x 12.58" D (171.4 x 198.1 x 319.5 mm).
Weight .....	9 lbs. (3.35 kg.).

ACCESSORIES AVAILABLE: See pages 18-20.



Power Measuring Equipment

# Auto-Log Digital Thermoelectric Power Meter

## Model 471



- Automatic range and scale selection
- Automatic zero setting
- Digital readout in watts and dBm
- Remotely programmable
- Over and under-range indicators
- 10 nanowatts to 3 watts direct reading
- 0.01 to 40 GHz frequency range
- $\pm 0.5\%$  of reading  $\pm 1$  count accuracy
- $< \pm 0.3\%$  peak-to-peak noise and drift
- Auxiliary tuning meter
- Analog and digital outputs, 1-2-4-8 BCD, TTL compatible

The Model 471, in conjunction with Series 420 and Series 44A **tft** power heads, measures modulated, pulsed and cw signals at power levels from 10 nanowatts to 3 watts over a frequency range from 0.01 to 40 GHz, with an accuracy of  $\pm 0.5\%$  of reading  $\pm 1$  count.

The instrument features fully automatic range and scale selection and zero-setting functions. In addition to the power reading (in watts or dBm), the front panel digital display includes automatic presentation of the measurement units, decimal point location, and polarity (+ or — for the dBm reading). Over-range and under-range indicators warn of false readouts and power overloads.

The all-purpose Model 471 is especially suited for use with automatic and computerized test systems, and is remotely programmable for automatic zero setting and range selection in both linear and logarithmic modes of operation.

Outputs available at the rear panel include a calibrated 0 to  $-1$  volt analog signal, BCD signals operating at TTL levels, range overload and underload, decimal point positions, conversion complete, and hold provisions. The Model 471 can also be ranged manually. Indicator lights provide the full scale value of the selected range. The scale automatically shifts from watt to dBm units when the mode selector is switched from LIN to LOG.

### **tft** Power Heads

A full line of thin-film thermoelectric waveguide and coaxial power heads is available for operation with the Model 471. The average power range of the meter is dependent on the specific power head used, as follows:

POWER HEAD MODEL	MODEL 471 POWER RANGE		
	Mode	From	To
N422C (coaxial)	LIN	0.01 $\mu$ W	1 mW
	LOG	-39.1 dBm	0 dBm
N420C, M440A, N440A, P440A (coaxial) X420C, U420C, K420C, A420C (waveguide)	LIN	0.10 $\mu$ W	10 mW
	LOG	-29.1 dBm	+10 dBm
N421D, M441A, N441A, P441A (coaxial)	LIN	1.0 $\mu$ W	100 mW
	LOG	-19.1 dBm	+20 dBm
N423 (coaxial)	LIN	0.1 mW	3W
	LOG	+0.9 dBm	+35 dBm

For complete description of these power heads, see pages 14-15.

## Specifications, Model 471

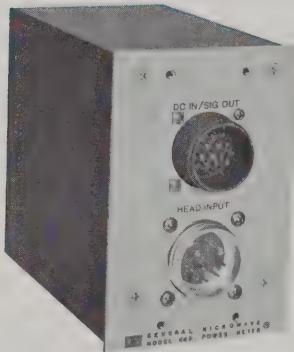
Instrument Type .....	Auto-ranging, digital-reading thermoelectric power meter for use with General Microwave Series 420 and 44A coaxial and waveguide power heads.
Operating Modes:	
Linear .....	Direct-reading in microwatts, milliwatts and watts.
Logarithmic .....	Direct-reading in dBm.
Power Ranges:	
Linear .....	From 10 nanowatts to 3.00 watts. Eight different ranges in four overlapping power scales with full scale readings of 1, 10 and 100 $\mu$ W; 1, 10 and 100 mW; 1 and 3W.
Logarithmic .....	From -39.1 dBm to +35 dBm. Eight different ranges in four overlapping power scales with full scale readings of +35, +30, +20, +10, 0, -10, -20 and -30 dBm.
Frequency Range .....	0.01 to 40 GHz, with appropriate power head.
Accuracy:	
Linear .....	$\pm 0.5\%$ of reading $\pm 1$ count.
Logarithmic .....	$\pm 0.1$ dB.
Display .....	Digital type, direct-reading in power, 3½ digits, plus polarity, measurement units, and over/under range indicators.
Range Selection .....	Automatic and manual, selectable by front-panel switch. Also remotely programmable.
Zero Set .....	Automatic, operated by front-panel switch. Also remotely programmable.
Operating Temperature Range .....	0 to +50°C.
Noise and Drift .....	$< \pm 0.3\%$ peak-to-peak of full scale (linear mode) on most sensitive range (1 $\mu$ W) at constant temperature; correspondingly less on higher ranges.
Analog Output .....	Calibrated output of -1.0 Vdc full scale; also adjustable from 0 to -1 Vdc full scale.
Digital Outputs .....	1-2-4-8 BCD, TTL compatible, including operating mode, numeric readout, measurement units, polarity, decimal point, conversion complete, and under/over range.
Response Time .....	NORMAL position, less than 1.5 sec.; FAST position approximately 100 msec.
Input Power .....	115/230V $\pm 10\%$ , 50-1000 Hz, 17W.
Input Connectors .....	Two provided, one on front panel and one on rear.
Dimensions (max.) .....	6.75" H x 7.8" W x 12.58" D (171.4 x 198.1 x 319.5 mm).
Weight .....	13 lbs. (4.85 kg.).



Power Measuring Equipment

# Power Meter Amplifier

## Model 468

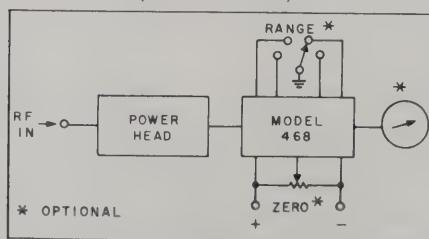


- **$\pm 0.5\%$  of full scale accuracy**
- **−40 dBm to +35 dBm power range**
- **$<\pm 1\%$  peak-to-peak noise and drift**
- **0.01 to 40 GHz frequency range**
- **Fully-militarized versions available**

The Model 468 is a chopper-stabilized dc amplifier with high gain stability, specially designed for use in rf systems requiring high-quality, drift-free power measurements. This unit enables the systems designer to construct his own power meter in modular form without losing any of the performance normally found only in complete laboratory instruments.

On the instrument's most sensitive range, −30 dBm full scale, noise and drift is less than  $\pm 1\%$  peak-to-peak of full scale, and is correspondingly less on the higher ranges. In applications where measurements are limited to power levels above −25 dBm, noise and drift are essentially negligible, thereby, eliminating zero setting. Thus, the Model 468 is ideally suited for systems requiring accurate unattended power measuring equipment with long-term stability.

The Model 468 is compatible with all Series 420 and 44A power heads. (See tabulation below for detailed information regarding power ranges when used with various power heads.)



For any power head selected, the Model 468 provides a choice of four power ranges yielding a dynamic range of 40 dB. Range selection is accomplished by contact closures to ground of the appropriate connector pins, as shown at left in the typical setup for measuring rf power.

The Model 468 can also be used with systems requiring multi-point measurements since individual amplifiers can be located at each measurement location, or several power heads can be programmed to feed a single Model 468 by means of a Series 963R Junction Box. (See page 18)

The Model 468 requires only a low voltage dc supply for operation. The use of a recorder, panel meter, range switch and zero-set control is optional.

Special versions of the Model 468 are available which feature automatic zero setting and fully automatic range selection. Both the standard and special versions can be supplied to meet military specifications.

### itt® Power Heads

A full line of thin-film thermoelectric waveguide and coaxial power heads is available for operation with the Model 468 Power Meter Amplifier. The average power range of the amplifier is dependent on the specific power head used, as follows:

POWER HEAD MODEL	MODEL 468 POWER RANGE	
	From	To
N422C (coaxial)	0.1 $\mu$ W (-40 dBm)	1 mW (0 dBm)
N420C, M440A, N440A, P440A (coaxial) X420C, U420C, K420C, A420C (waveguide)	1 $\mu$ W (-30 dBm)	10 mW (+10 dBm)
N421D, M441A, N441A, P441A (coaxial)	10 $\mu$ W (-20 dBm)	100 mW (+20 dBm)
N423 (coaxial)	1 mW (0 dBm)	3 W (+35 dBm)

For complete description of these power heads, see pages 14-15.

## Specifications, Model 468

Frequency Range .....	0.01 to 40 GHz, with appropriate power heads.
Power Range .....	From 0.1 $\mu$ W to 3 W (-40 to +35 dBm). Eight different ranges in four overlapping power scales, with full-scale readings of 1, 10 and 100 $\mu$ W; 1, 10 and 100 mW; 1 and 3 W.
Accuracy .....	$\pm 0.5\%$ full scale.
Temperature Range .....	0 to 55°C.
Input Power .....	$\pm 12$ to $\pm 15$ VDC, 100 mA (+) and 50 mA (-), 0.1% regulation.
Response Time .....	1.5 seconds (max.)
Noise and Drift .....	$< \pm 1\%$ peak-to-peak of full scale on most sensitive range; correspondingly less on the higher ranges.
Zero Carryover .....	Single electrical zeroing on most sensitive range carries over from range to range.
Dimensions .....	3.5" W x 5.1" H x 5.9" D (89 x 130 x 150 mm).
Approximate Weight .....	2.5 lbs. (.93 kg.).



# tft® Power Heads, Miniature Coaxial and Waveguide

# Power Measuring Equipment

## Series 44 A and 420

**(For use with Power Meter Models 460B, 471 and Amplifier Model 468)**



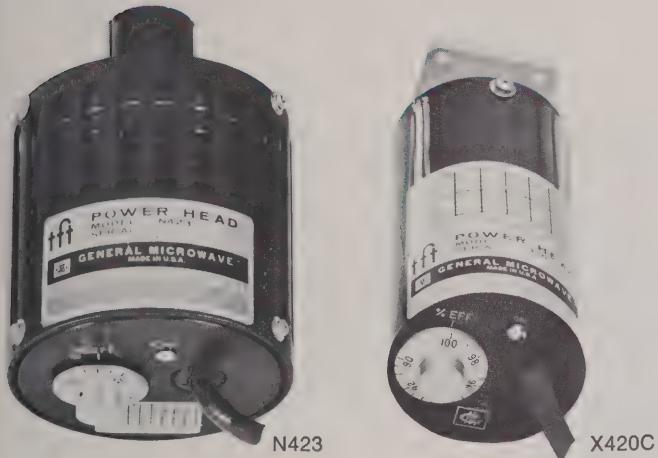
- 0.01 to 40 GHz frequency range
- Type SMA, N, or APC-7 coaxial connectors
- 10 nanowatts to 3 watts power range
- Self-contained efficiency compensator
- Field-replaceable elements
- Up to 300% overload protection
- Individually calibrated against NBS-certified standards
- Can be operated at distances up to several hundred feet from the power meter

These two series of power heads utilize the same proven power measuring techniques discussed in the Series 4200 description on page 6. Available in waveguide or coaxial models with type SMA, N or APC-7 coaxial connectors, they are designed for use with Models 460B and 471 power meters, and with the Model 468 power meter amplifier. Measurements of power levels as low as 0.01  $\mu$ W (-50 dBm) can be made with the Model N422C. Direct-reading power measurements up to 3 watts (+35 dBm) can be made with the Model N423. Other models provide intermediate power ranges.

Each power head is factory-calibrated for effective efficiency at various fixed frequencies over its band and tested on a swept-frequency basis. The data are stamped on a graph mounted on the power head enclosure. A calibrated control is provided on each power head to correct for its effective efficiency. When this control is set to the measured or interpolated value, the power meter will automatically correct for and eliminate this error.

These power heads can be operated at distances up to several hundred feet from the power meter. Standard units are provided with a five-foot umbilical cable. Special length cables or General Microwave extension cables (see page 20) can be provided where greater separation between the power head and instrument is required.

\*Patent Nos. 3,384,819 and 3,694,746



## Specifications, Series 44 A and 420

MODEL NO.	COAXIAL TYPES, SERIES 420				COAXIAL TYPES, SERIES 44A					WAVEGUIDE TYPES, SERIES 420				
	N420C	N421D	N422C	N423	M440A	N440A	P440A	M441A	N441A	P441A	X420C	U420C	K420C	A420C
Frequency Range (GHz)	0.01-12.4				0.01-22 <sup>①</sup>	0.01-18	0.01-18	0.01-22 <sup>①</sup>	0.01-18	0.01-18	8.2-12.4	12.4-18.0	18.0-26.5	26.5-40.0
Transmission Line	Coaxial				Coaxial					RG-52/U RG-91/U RG-53/U RG-96/U				
Input Connector Type	N-Male				SMA-Male	N-Male	APC-7	SMA-Male	N-Male	APC-7	UG-39/U	UG-419/U	UG-595/U	UG-599/U
Max. Average Power	10 mW (+10 dBm)	100 mW (+20 dBm)	1 mW (0 dBm)	3 W (+35 dBm)	10 mW (+10 dBm)		100 mW (+20 dBm)		10 mW (+10 dBm)					
Overload Rating <sup>②</sup>	300%	300%	300%	300%	300%		200%		300%		300%			
Max. Pulse Energy at +25°C (W-μsec)	15	150	1.5	300	5		30		10		5			
Max. Pulse Power at +25°C (W)	3	30	0.3	60	1		15		2		1			
Max. Pulse Duration <sup>③</sup> at +25°C (μsec)	5	5	5	5	5		2		5		5			
Max. VSWR	1.5 <sup>③</sup>	1.5 <sup>③</sup>	1.5 <sup>③</sup>	1.5 <sup>④</sup>	1.35 <sup>⑤</sup>		1.35 <sup>⑤</sup>		1.5	1.5	1.5	1.65		
Element Temperature Sensitivity	0.1% /°C				0.1% /°C		0.1% /°C		0.1% /°C					
Field-Replaceable Elements	TL-0A	TL-1A	TL-2A	TL-3	TL-4A	TL-4A	TL-4A	TL-5	TL-5	TL-5	TL-X0-A	TL-U0-A	TL-K0-A	TL-A0-A
Diameter	⑥ 2.12" (54mm)		⑥ 3.03" (77mm)		⑦ 1.29" (33mm)	⑦ 1.29" (33mm)	⑦ 1.29" (33mm)	⑦ 1.29" (33mm)	⑦ 1.29" (33mm)	⑦ 1.29" (33mm)	⑥ 2.12" (54mm)			
Length	2.50" (63mm)		2.90" (74mm)		2.66" (68mm)	3.16" (80mm)	3.23" (82mm)	2.66" (68mm)	3.16" (80mm)	3.23" (82mm)	3.74" (95mm)			
Weight, approx.	16 oz. (430gm)		24 oz. (630gm)		3 oz. (85gm)		32 oz. (850gm)							

<sup>①</sup> For Models M440A and M441A, the upper frequency limit on standard units is 18 GHz; operation to 22 GHz is available on special order.

<sup>②</sup> While the heads will take overloads for short periods of time, extended periods of operation at overload levels may result in permanent change in the element characteristics or even burnout. Maximum care should be exercised to avoid such an occurrence.

<sup>③</sup> Except in the range from .010 to .015 GHz where VSWR may rise to 1.75.

<sup>④</sup> Except in the range from .010 to .015 GHz where VSWR may rise to 1.75, and from 11.5 to 12.4 GHz where VSWR may rise to 2.0.

<sup>⑤</sup> Except in the range from .010 to .015 GHz where VSWR may rise to 1.5, and from 10 GHz to upper limit where VSWR may rise to 1.6.

<sup>⑥</sup> Maximum, excluding rf connector, cable, multi-pin connector and efficiency control.

<sup>⑦</sup> Maximum, including rf connector, cable, multi-pin connector and efficiency control.

<sup>⑧</sup> At maximum pulse power.



Power Measuring Equipment

# Integrated Thermoelectric Power Monitors

Models N425A, N426A, N427A



- **Amplifier and power sensor in a single, compact package**
- **0.01 to 12.4 GHz frequency range**
- **30 dB dynamic power range**
- **$\pm 1\%$  accuracy**
- **$-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  temperature range**
- **0.02% F.S. (p-p) noise**
- **0.02% F.S./ $^{\circ}\text{C}$  drift**

These Power Monitors\* are compact, integrated assemblies of thermoelectric power sensors and dc amplifiers specially designed for system power monitoring at local or remote locations. Small size and light weight make them ideal for difficult systems packaging requirements, and choice of readout type and location is flexible—all this is accomplished without sacrificing high accuracy, excellent stability or economy.

Modulated, pulsed, or cw signals from 0.01 to 12.4 GHz are measured over a 30 dB dynamic range covered in three convenient decade steps. Power levels as low as  $-30\text{ dBm}$  ( $1\text{ }\mu\text{W}$ ) and as high as  $+20\text{ dBm}$  ( $100\text{ mW}$ ) can be measured. Provisions for remote range selection and zero setting are included.

The monitor output is a dc analog signal which may be connected to readouts in either a constant current or constant voltage mode, directly scaleable in milliwatts. The constant current output is 1 milliamper full scale, and the constant voltage output is adjustable up to  $-10$  volts full scale. For remote readout distances up to many hundreds of feet, the constant current connection provides a stable reading free from errors caused by long line wire resistance values. Where the readout device is a voltmeter, or for such applications as sweep generator levelling, the constant voltage mode of operation is available.

The carefully designed amplifier section, when combined with the excellent stability of the thermoelectric power sensor, assures exceptionally low noise and drift. A wide operating temperature range of  $-55^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$  is also featured.

The Type N rf connector conforms to MIL-C-39012, and the dc and signal output connector mates with a furnished MS3116E plug connector. Rugged construction is featured throughout.

\*Patent No. 3,384,819

## Specifications, Models N425A, N426A, N427A

MODEL	N425A		N426A		N427A			
Frequency Range	0.01 to 12.4 GHz							
Full Scale Ranges:	dBm	mW	dBm	mW	dBm	mW		
Range 1	+10	10	+20	100	0	1		
Range 2	0	1	+10	10	-10	0.1		
Range 3	-10	0.1	0	1	-20	0.01		
Input Impedance	50 ohms							
Max. VSWR <sup>①</sup>	1.5							
Accuracy <sup>②</sup>	±1% of full scale							
Operating Temperature Range	-55°C to +85°C							
Zero Drift <sup>③④</sup>	0.02% F.S./°C		0.02% F.S./°C		0.035% F.S./°C			
Noise <sup>③</sup>	0.02% F.S. (p-p)		0.02% F.S. (p-p)		0.035% F.S. (p-p)			
Element Temperature Sensitivity	0.1% /°C		0.1% /°C		0.1% /°C			
Input Overload	300%		300%		300%			
Max. Pulse Energy at +25°C (W-μsec)	15		150		1.5			
Max. Pulse Power at +25°C (W)	3		30		0.3			
Max. Pulse Duration at +25°C (μsec) <sup>⑤</sup>	5		5		5			
Max. dc Voltage (volts)	10		30		3			
Output:	1 mA full scale, each range -10 volts full scale (maximum), each range							
Current Mode								
Voltage Mode								
Power Supply Requirements	±6V to ±18V, 10 mA, 0.1% regulation							
Size	3.1" L. x 2.03" D. (79 x 52 mm)							
Weight	8 oz. (227 gm.)							

<sup>①</sup> Except 1.75 from 0.01 to .015 GHz.

<sup>②</sup> Excluding RF calibration error.

<sup>③</sup> On least sensitive range. Proportionately more on lower power ranges.

<sup>④</sup> Over temperature range from -25°C to +85°C. 0.03% F.S./°C over full temperature range for the Models N425A and N426A, 0.05% F.S./°C for the Model N427A.

<sup>⑤</sup> At maximum pulse power.

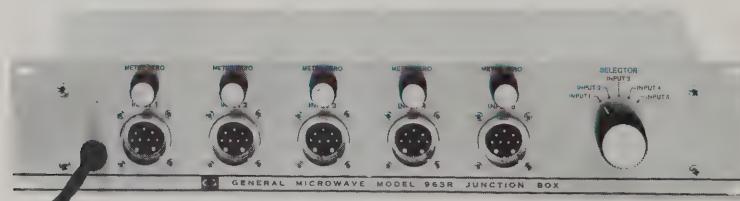


## Power Measuring Equipment

# Accessories

### Series 963R Junction Boxes

- **Multi-point power measurements with one power meter**
- **Accommodates up to five power heads**
- **Separate zero set control for each power head**
- **Remotely programmable**



#### Model 963R-4

This remotely programmable unit is designed to permit the operation of up to five **tft** power heads with most of General Microwave's thermoelectric power meters and power meter amplifiers, thus enabling the user to rapidly measure power levels at different test points. Remote programming is accomplished by driving a solenoid switch to the desired position with application of a +28Vdc signal.

Unlike thermistor or bolometer detectors, the thermoelectric elements in GMC power heads require no bias currents and consequent warm-up time. Thus, essentially instantaneous power readings are obtained when switching from one power head to another. Since all circuits being switched by the junction box are dc, errors commonly associated with rf switching are avoided, and distances between the test points and the junction box can be varied as desired. Low-noise, reliable performance is obtained by the use of special silver-alloy contacts in the power head selector switch.

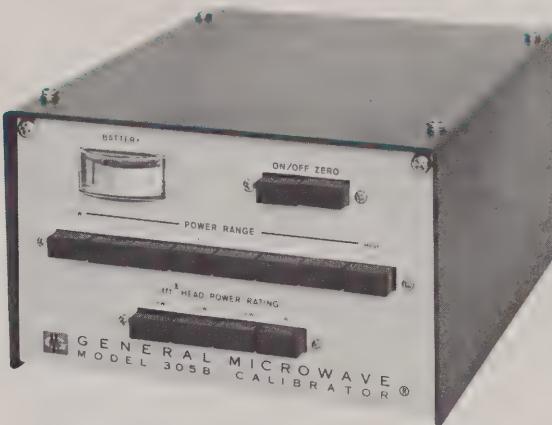
Mounted on the rear panel of the Model 963R-4 are five input connectors for mating with the power heads. Also included on the rear panel is a cable-mounted output plug which connects with the power meter. A separate zero-set control for each power head is located on the front panel. For convenience, the junction box is provided with a standard 19-inch rack-mounting front panel.

#### Model 963R-6

Same as the Model 963R-4 except that position selection can be made either manually from the front panel or from a remote location.

## Specifications

Instrument Type .....	Junction Box for switching any one thermoelectric power meter or power meter amplifier among five power heads.
For Use With .....	Series 460, 467, 471 Power Meters and 468 Power Meter Amplifier; Series 420 and 44A Power Heads.
Input Connectors .....	5 power head input connectors mounted on front or rear panel.
Output Cable .....	6 ft. (183cm.) long with power head connector.
Dimensions .....	19"W (standard rack mounting) x 3.5"H x 5.1"D (482x28x130mm)
Weight .....	7 lbs. (3.2kg.).



## Model 305B Calibrator

- **Rapid, precise calibration of GMC thermoelectric power meters and power meter amplifiers**
- **No external equipment required**
- **Battery-operated with built-in battery checker**
- **Push-button voltage selector**
- **Push-button sensitivity selector**

The Model 305B Calibrator simplifies rapid calibration of General Microwave Series 460, 467 and 471 thermoelectric power meters and Series 468 power meter amplifiers. Using self-contained long-life mercury batteries in conjunction with a highly stable voltage reference, the Model 305B establishes a standard voltage level which is scaled by a precision divider to the eight discrete values required to calibrate the full-scale levels of each of the power meter ranges.

The Model 305B is a completely self-contained unit, requiring no external instruments for the calibration process. The condition of the internal batteries is easily checked by means of the front panel meter provided for that purpose. There are no other checks or adjustments necessary to prepare the calibrator for use.

A four-position push-button switch is provided, each position corresponding to one of the four available power head sensitivities. This selector switch checks the operation of the scale indicator circuitry of the power meter under test.

An eight-position push-button switch is employed to provide the full-scale voltages required to calibrate all of the power ranges of the power meter under test.

For added convenience, the Model 305B comes equipped with an output cable which connects directly to the input of the power meter under test.

## Specifications

Instrument Type .....	Calibrator for use with thermoelectric power meters and power meter amplifiers.
For Use With .....	Series 460, 467, 471 Power Meters Model 468 Power Meter Amplifier
Input Power .....	Supplied by self-contained mercury batteries. Battery check meter included.
Accuracy at 25°C ±5°C:	
Ranges 1-2 .....	±0.1%
Ranges 3-8 .....	±0.05%
Temperature Coefficient ...	±0.005% /°C
Long Term Stability Error ...	<0.005% /year
Output Cable .....	6 ft. (183 cm.) long with power head connector.
Dimensions .....	3.8"H x 6.0"W x 7.7"D (96,5 x 152,4 x 195,5 mm)
Weight .....	3 lbs. (1,1 kg)



## Accessories

### Power Measuring Equipment



#### Model TK-1 Tool Kit

The Model TK-1 contains all the special tools necessary for field replacement of **tft** elements in any Series 420 coaxial power head. Other **tft** power heads require no special tools for element replacement.

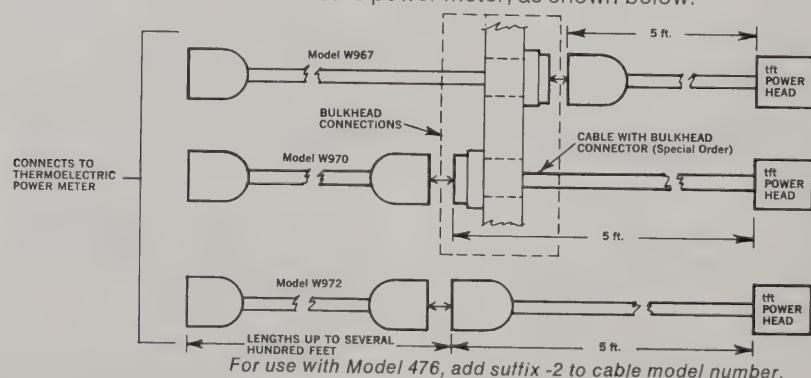


#### Model 983-1 Rack Adapter

The Model 983-1 provides a convenient means of rack-mounting any General Microwave half-rack instrument by itself, with any other General Microwave half-rack unit, or with suitable half-rack units of other manufacturers.

### Special Cables

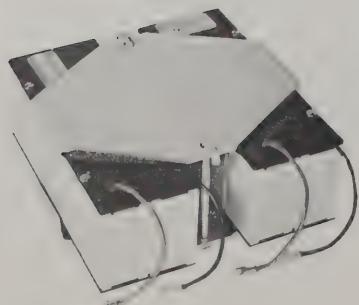
An assortment of special extension cables in various lengths is available to enable power measurements at distances up to several hundred feet from a General Microwave thermoelectric power meter, as shown below.



### Series 981 Rechargeable Battery Packs

**Model 981:** Permits Model 460B power meter to be used for portable or field applications. Includes two 12-volt, 1.2 amp-hr. sealed nickel-cadmium batteries. A fully-charged pack can power a Model 460B for approximately 16 hours. The pack can be re-charged while installed in an energized power meter.

**Model 981-1:** Designed for use with Model 476 power meter. Includes one 24-volt battery, can power a Model 476 for approximately 12 hours.





# PIN Diode Control Devices

General Microwave's line of high-performance, high-reliability PIN Diode Control Devices represents the industry's most complete selection of switches, modulators, and attenuators.

## THE PIN DIODE

The PIN diode is a semiconductor device consisting of an intrinsic (high resistivity) layer sandwiched between highly doped *p* and *n* layers. The resistance of the diode is a function of the charge density present in the intrinsic region, which is in turn determined by the forward bias current applied to the diode. The usefulness of the PIN diode derives from its behavior as a linear resistor for all rf signal frequencies that are substantially higher than a low frequency limit,  $f_o$ , which is primarily a function of the minority carrier lifetime of the intrinsic material.

Thus, the PIN diode can be described as an ideal current-variable microwave resistive element over broad frequency ranges when properly mounted in an rf transmission line and when the required dc bias is applied to the PIN diode without either disturbing the rf transmission line's characteristic impedance or contributing significant loss of its own. This element can then be placed in series, shunt, or series-shunt configurations to provide a variety of broadband attenuation, modulation or switching functions.

## SELECTION GUIDE

Product	Frequency Range, GHz	Description	Designation	Page No.
SPST SWITCHES (Without Driver)	0.1-18 2-18, 0.2-4	Ultra-Broadband Broadband, Miniature	Series M86 Series 91, 92	22 34
SPST SWITCHES (With Integral Driver)	0.1-18 2-18, 0.2-4	Ultra-Broadband Broadband, Miniature	Series DM86, FM86 Series F91, F92	24 36
SP2T SWITCHES (Without Driver)	0.2-18 2-18, 0.2-4 1.5-4.5, 3-9, 6-18	Ultra-Broadband Broadband, Miniature High Speed, Miniature	Series M87 Series 91, 92 Series 892	26 38 30
SP2T SWITCHES (With Integral Driver)	0.2-18 2-18, 0.2-4 1.5-4.5, 3-9, 6-18	Ultra-Broadband Broadband, Miniature High Speed, Miniature	Series DM87, FM87 Series F91, F92 Series F892	28 40 32
SP3T SWITCHES (Without Driver)	0.2-18 2-18, 0.2-4	Ultra-Broadband Broadband, Miniature	Series M87 Series 91, 92	26 38
SP3T SWITCHES (With Integral Driver)	0.2-18 2-18, 0.2-4	Ultra-Broadband Broadband, Miniature	Series FM87 Series F91, F92	28 40
SP4T SWITCHES (Without Driver)	0.2-18	Ultra-Broadband	Series M87	26
SP4T SWITCHES (With Integral Driver)	0.2-18	Ultra-Broadband	Series DM87, FM87	28
SP5T SWITCHES (Without Driver)	0.2-18	Ultra-Broadband	Series M87	26
SP5T SWITCHES (With Integral Driver)	0.2-18	Ultra-Broadband	Series FM87	28
SPST ABSORPTIVE SWITCHES (PULSE MODULATORS) (With Integral Driver)	0.2-18 0.2-18 0.2-18	30 dB, Ultra-Broadband 45 dB, Ultra-Broadband 60 dB, Ultra-Broadband	Model DM190H Model DM186BH Model DM189H	46 46 46
ABSORPTIVE ATTENUATORS/ MODULATORS (Without Driver)	0.2-18 0.2-18 0.2-18 1.5-4.5, 3-9, 6-18	30 dB, Ultra-Broadband 45 dB, Ultra-Broadband 60 dB, Ultra-Broadband 60 dB, High Speed, Miniature	Model M190 Model M186B Model M189 Models 1952, 1954, 1958	48 48 48 42
ABSORPTIVE MODULATORS (With Integral Linearizing Driver)	1.5-4.5, 3-9, 6-18	60 dB, High Speed, Miniature	Models D1952, D1954, D1958	44
PROGRAMMABLE ATTENUATORS	0.2-18	Ultra-Broadband	Series 325	50
PIN Diode Control Devices—Environmental Ratings, Dimensions and Weights				52-58



# Ultra-Broadband SPST PIN Diode Switches

PIN Diode Control Devices

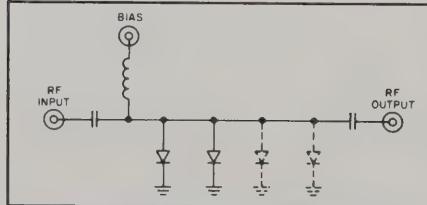
## Series M86

Actual Size



- **0.1 to 18 GHz frequency range**
- **Low VSWR and insertion loss**
- **Up to 85 dB isolation**
- **As fast as 10 ns switching speed**
- **Small size, light weight**

The Series M86\* is a diverse group of high performance broadband SPST switches. Included are three low insertion loss models and six high speed models, all of which operate up to 18 GHz. Each model features an integrated circuit assembly of up to four chip PIN diodes mounted in a thin-film microstrip transmission line as well as a patented bias line that contributes to the broadband low-loss performance.



The circuit configuration is shown at the left. By applying positive current to the bias terminal, the diodes are biased to low resistances and the switch is OFF. With zero or negative voltage at the bias terminal, the diodes are biased to high resistances and the switch is ON.

### LOW INSERTION LOSS MODELS

Models M862A, M863 and M864 operate over the frequency range from 0.1 to 18 GHz. They exhibit nominal isolation characteristics of 40, 60 and 80 dB, respectively, with maximum ON-to-OFF and OFF-to-ON switching speed of 50 nanoseconds.

### HIGH SPEED MODELS

For higher speed requirements, Models M862AH, M863H and M864H are available. These operate from 0.5 to 18 GHz and feature maximum ON-to-OFF and OFF-to-ON switching speeds of 10 nanoseconds. Optional models M862AH/25, M863H/25 and M864H/25 operate from 0.1 to 18 GHz with maximum switching speeds of 20 nanoseconds.

### ALTERNATE CONFIGURATIONS

Options for rf and bias connector selection are described on page 23. In addition, all models of the Series M86 are also available with integral drivers—see pages 24-25 for full technical details.

\*Patent No. 3,812,438

## Specifications, Series M86

MODEL NO.		ISOLATION, INSERTION LOSS, VSWR (shown for various frequencies)						SWITCHING SPEED ②	POWER HANDLING CAPABILITY ③		BIAS CONDITIONS			
		CHARACTERISTIC	FREQUENCY (GHz)						ON-to-OFF and OFF-to-ON (nsec.)	Average (watts)	Peak, 1 $\mu$ sec. max. pulse width (watts)	For Rated Insertion Loss	For Rated Isolation	
LOW INSERTION LOSS MODELS	M862A		Min Isolation (dB)	28	30	38	45	45	45	50	5	75	0V	+50 mA
	M863	Max Insertion Loss (dB)	1.0	1.0	1.0	1.3	1.6	1.6	2.0					
	M864	Max VSWR (ON position)	1.3	1.3	1.3	1.6	1.75	1.75	1.75					
HIGH SPEED MODELS ①	M862AH	Min Isolation (dB)	34	40	50	63	63	63	63	50	5	75	0V	+75 mA
	M863H	Max Insertion Loss (dB)	1.0	1.0	1.2	1.6	2.0	2.3	2.3					
	M864H	Max VSWR (ON position)	1.4	1.4	1.4	1.75	1.75	1.75	1.85					
LOW INSERTION LOSS MODELS	M862A	Max Isolation (dB)	1.2	1.2	1.3	1.9	2.3	2.6	2.6	50	5	75	0V	+100 mA
	M863	Max Insertion Loss (dB)	1.3	1.3	1.5	1.7	2.0	2.2	2.2					
	M864	Max VSWR (ON position)	1.4	1.4	1.4	1.75	1.75	2.2	2.2					
HIGH SPEED MODELS ①	M862AH	Min Isolation (dB)	33	40	45	45	45	45	45	10	2	10	-10V	+35 mA
	M863H	Max Insertion Loss (dB)	1.0	1.0	1.0	1.3	2.0	2.3	2.3					
	M864H	Max VSWR (ON position)	1.3	1.3	1.5	1.7	2.0	2.2	2.2					

① Models M862AH, M863H and M864H operate from 0.5 to 18 GHz. The addition of Option 25 to these models permits operation from 0.1 to 18 GHz, with max. switching speed of 20 nanoseconds.

② Switching speed, defined as the time interval between 10% and 90% of the output rf power level, is rated for units driven by shaped current pulses.

③ At  $-65^{\circ}\text{C}$  to  $+25^{\circ}\text{C}$ . See power derating curve (Fig. 1) for higher temperatures.

### ENVIRONMENTAL RATINGS

Temperature Range .... Operating and non-operating:  $-65^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

Humidity, Shock, etc. .... Per MIL-STD-202C (See page 52 for details)

### DIMENSIONS & WEIGHTS

See page 52 for dimensional and weight data.

### AVAILABLE OPTIONS

#### Option No. Description

- 3 SMA female bias connector
- 4 Solder-type bias terminal
- 7 Two SMA male rf connectors
- 10 One SMA male and one SMA female rf connector
- 25 0.1 to 18 GHz range, 20ns switching speed  
(available only on M862AH, M863H and M864H)
- 33 EMI filter bias terminal

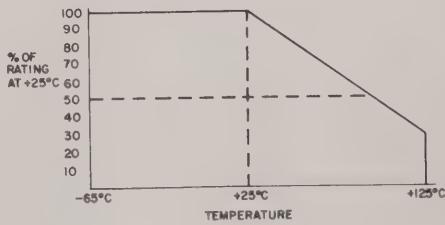


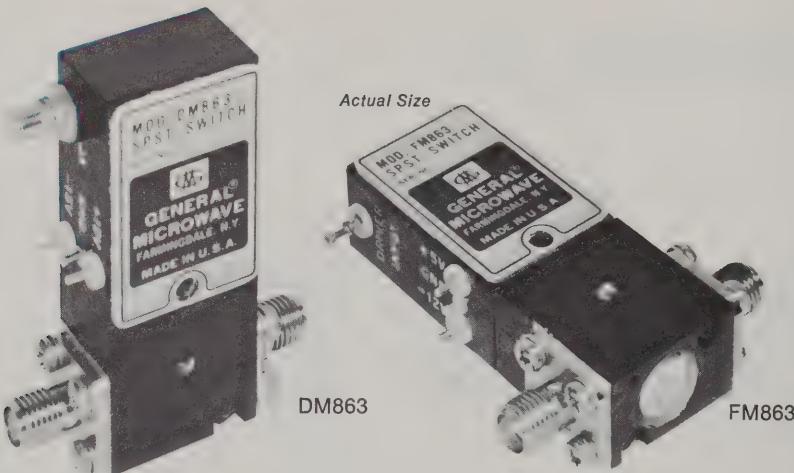
Fig. 1 Peak and average power derating factors



## PIN Diode Control Devices

# Ultra-Broadband SPST PIN Diode Switches With Integral Drivers

## Series DM86 and FM86



- **0.1 to 18 GHz frequency range**
- **Low VSWR and insertion loss**
- **Up to 85 dB isolation**
- **As fast as 10 ns switching speed**
- **Small size, light weight**

The Series DM86\* and FM86\* are high performance broadband SPST switches with integral drivers. DM86 switches are powered by  $\pm 15$  volt supplies; FM86 units are powered by +5 and -12 volt supplies. Included in each series are three low insertion loss models and six high speed models, all of which operate up to 18GHz. Each model features a unique integrated circuit assembly of up to four chip PIN diodes mounted in a thin-film microstrip transmission line as well as a patented bias line that contributes to the broadband low-loss performance.

The proper current required to switch each unit ON or OFF is provided by the driver, which is controlled by a logic signal applied by the user.

### LOW INSERTION LOSS MODELS

Models DM862A, DM863, DM864 and FM862A, FM863 and FM864 operate over the frequency range from 0.1 to 18GHz. The three models in each series exhibit nominal isolation characteristics of 40, 60 and 80dB, respectively, with maximum ON-to-OFF and OFF-to-ON switching speeds of 50 nanoseconds.

### HIGH SPEED MODELS

For higher speed requirements, Models DM862AH, DM863H, DM864H and FM862AH, FM863H and FM864H are available. These operate from 0.5 to 18GHz and feature maximum ON-to-OFF and OFF-to-ON switching speeds of 10 nanoseconds. These same models, with the addition of Option 25, can operate from 0.1 to 18GHz with maximum switching speeds of 20 nanoseconds.

### ALTERNATE CONFIGURATIONS

Options for control input impedance and logic, as well as rf and control connector selection are described on page 25. In addition, all models in the Series DM86 and FM86 are also available without integral drivers—see pages 22-23 for full technical details.

\*Patent No. 3,812,438

## Specifications, Series DM86 and FM86

MODEL NO.		ISOLATION, INSERTION LOSS, VSWR (shown for various frequencies)							SWITCHING SPEED ②	POWER HANDLING CAPABILITY ③		POWER SUPPLY REQUIREMENTS			
		CHARACTERISTIC						FREQUENCY (GHz)			Average (watts)	Peak, 1 $\mu$ sec. max. pulse width (watts)	For +15VDC ±5%	For -15VDC ±5%	For +5VDC ±2%
LOW INSERTION LOSS MODELS	DM862A	Min Isolation (dB)	28	30	38	45	45	45	50	5	75	70 mA	20 mA	—	—
	DM862A	Max Insertion Loss (dB)	1.0	1.0	1.0	1.3	1.6	2.0	2.0	—	—	—	95 mA	1 mA	—
	FM862A	Max VSWR (ON position)	1.3	1.3	1.3	1.6	1.75	1.75	—	—	—	—	95 mA	1 mA	—
	DM863	Min Isolation (dB)	34	40	50	63	63	63	50	5	75	95 mA	20 mA	—	—
	DM863	Max Insertion Loss (dB)	1.0	1.0	1.2	1.6	2.0	2.3	50	—	—	—	95 mA	1 mA	—
	FM863	Max VSWR (ON position)	1.4	1.4	1.4	1.75	1.75	1.85	—	—	—	—	95 mA	1 mA	—
HIGH SPEED MODELS ①	DM864	Min Isolation (dB)	38	50	65	80	80	78	50	5	75	120 mA	20 mA	—	—
	DM864	Max Insertion Loss (dB)	1.2	1.2	1.3	1.9	2.3	2.6	50	—	—	—	95 mA	1 mA	—
	FM864	Max VSWR (ON position)	1.4	1.4	1.4	1.75	1.75	2.2	—	—	—	—	95 mA	1 mA	—
	DM862AH	Min Isolation (dB)	33	40	45	45	45	45	10	2	10	55 mA	20 mA	—	—
	DM862AH	Max Insertion Loss (dB)	1.0	1.0	1.0	1.3	2.0	2.3	10	—	—	—	95 mA	1 mA	—
	FM862AH	Max VSWR (ON position)	1.3	1.3	1.5	1.7	2.0	2.2	—	—	—	—	95 mA	1 mA	—
HIGH SPEED MODELS ①	DM863H	Min Isolation (dB)	40	60	70	70	70	70	10	2	10	70 mA	20 mA	—	—
	DM863H	Max Insertion Loss (dB)	1.0	1.0	1.2	1.6	2.4	3.0	10	—	—	—	95 mA	1 mA	—
	FM863H	Max VSWR (ON position)	1.4	1.4	1.5	1.7	2.0	2.2	—	—	—	—	95 mA	1 mA	—
	DM864H	Min Isolation (dB)	45	70	85	85	85	80	10	2	10	90 mA	20 mA	—	—
	DM864H	Max Insertion Loss (dB)	1.2	1.2	1.3	1.9	2.6	3.2	10	—	—	—	95 mA	1 mA	—
	FM864H	Max VSWR (ON position)	1.4	1.4	1.5	1.7	2.0	2.2	—	—	—	—	95 mA	1 mA	—

① Models DM862AH, DM863H, DM864H and FM862AH, FM863H, FM864H operate from 0.5 to 18 GHz. The addition of Option 25 to these models permits operation from 0.1 to 18 GHz, with max. switching speed of 20 nanoseconds.

② Switching speed is defined as the time interval between 10% and 90% of the output rf power level.

③ At  $-65^{\circ}\text{C}$  to  $+25^{\circ}\text{C}$ . See power derating curves (Figs. 1 and 2) for higher temperatures.

### CONTROL CHARACTERISTICS

Control Input Impedance. TTL compatible, two-unit load.  
(A unit load is 1.6 mA sink current and 40  $\mu\text{A}$  source current.)

Control Logic Series DM86 ..... Logic "0" (-0.3 to +0.7 volt) for switch OFF and logic "1" (+2.5 to +5.0 volts) for switch ON.

Series FM86 ..... Logic "0" (-0.3 to +0.7 volt) for switch ON and logic "1" (+2.5 to +5.0 volts) for switch OFF.

### ENVIRONMENTAL RATINGS

Operating Temperature Range:  
Series DM86 .....  $-65^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$   
Series FM86 .....  $-65^{\circ}\text{C}$  to  $+110^{\circ}\text{C}$

Non-Operating Temperature Range ...  $-65^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$   
Humidity, Shock, etc..... Per MIL-STD-202C (See page 52 for details)

### DIMENSIONS & WEIGHTS

See page 52 for dimensional and weight data.

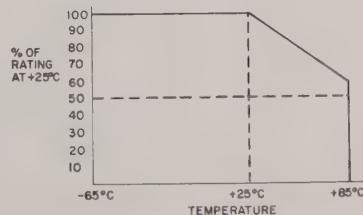


Fig. 1 DM86 Peak and average power derating factors

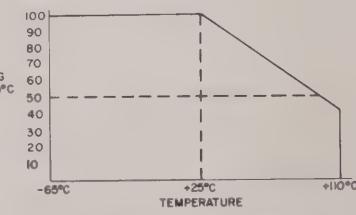


Fig. 2 FM86 Peak and average power derating factors

### AVAILABLE OPTIONS

Option No.	Description
7	Two SMA male RF connectors
9	Inverse logic
10	One SMA male and one SMA female RF connector
20*	Two-unit load control input impedance
25	0.1 to 18 GHz range, 20 ns switching speed (available only on high-speed models).
30	Solder-type control terminal (Standard in FM models)

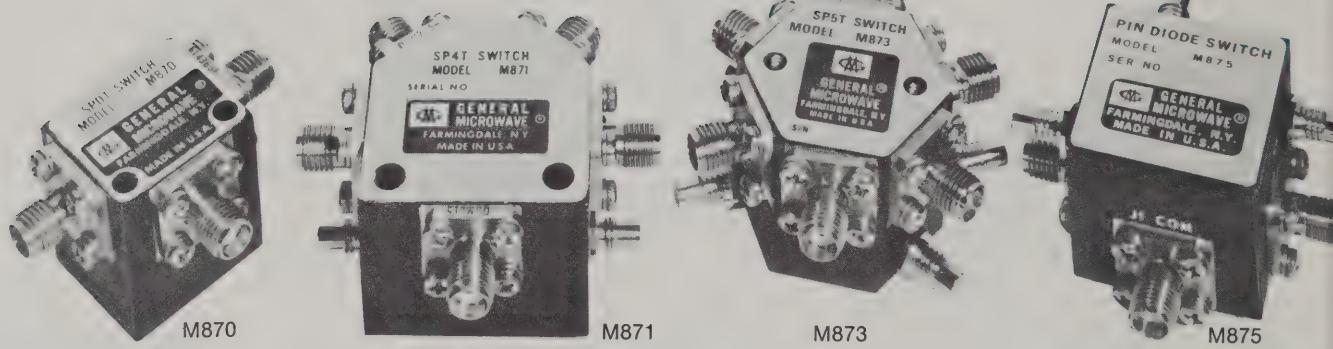
\* All models are furnished with this option unless otherwise specified by customer. Other options, such as 50 ohms to ground, are available on special order.



# Ultra-Broadband SPMT PIN Diode Switches

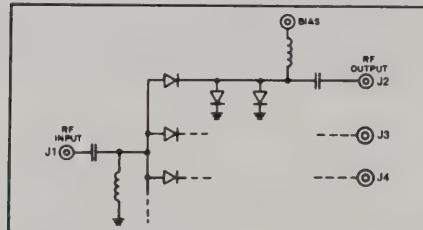
PIN Diode Control Devices

## Series M87



- **0.2 to 18 GHz frequency range**
- **Low VSWR and insertion loss**
- **Up to 60 dB isolation**
- **Small size, light weight**

The Series M87\* is a line of high-performance broadband single-pole multi-throw switches. Included are models with from two to five positions, all of which operate over the full instantaneous bandwidth of 0.2 to 18.0 GHz. Design features common to all models include an integrated circuit assembly of beam-lead and chip PIN diodes mounted in a thin-film microstrip transmission line as well as a patented bias line that contributes to the broadband low-loss performance.



conditions are established and the port is ON. Since bias terminals are individually available for each port, the user has the option of operating with any combination of ports ON or OFF subject to the limitation of total bias current given below.

The typical circuit configuration of the Series M87 is shown at the left. By applying positive current to a bias terminal, the associated port is OFF since the corresponding shunt diodes are biased to a low resistance and the series diode to a high resistance. With negative current at the bias terminal, the converse

Each model in the Series M87 is also available at lower cost for operation over a reduced frequency range—from 0.2 to 12.4 GHz. Within this frequency range, all performance specifications are the same as for the broader band models. (To order these lower cost versions, add the prefix A to the model number. For example: Model AM875)

### ALTERNATE CONFIGURATIONS

Options for rf and bias connector selection, as well as temperature range, are described on page 27. In addition, all models in the Series M87 are also available with integral drivers—see pages 28-29 for full technical details.

\*Patent No. 3,812,438

## Specifications, Series M87

MODEL NO.	CHARACTERISTIC	FREQUENCY (GHz)			
		0.2 to 4.0	4.0 to 8.0	8.0 to 12.4	12.4 to 18.0
M870 (SP2T)	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.5	55 1.5 1.75	55 1.75 1.75	55 2.2 2.0
M875 (SP3T)	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.5	55 1.5 1.75	50 1.75 1.75	50 2.5 2.0
M871 (SP4T)	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.5	55 1.5 1.75	50 2.0 1.75	50 2.5 2.0
M873 (SP5T)	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.5	55 1.5 1.75	50 2.0 1.75	50 3.0 2.0

### PERFORMANCE CHARACTERISTICS

Switching Speed<sup>①</sup> ..... 500 nanoseconds maximum when driven by a shaped current pulse.

Power Handling Capability (from  $-65^{\circ}\text{C}$  to  $+25^{\circ}\text{C}$ ;  
see power derating curve, Fig. 1, for higher temperatures)

Average Power ..... 2W

Peak Power  
(1  $\mu\text{sec}$  max. pulse width) .. 75W

Bias Current Required at Each Port for  
Rated Isolation and Insertion Loss<sup>②</sup>

Port OFF .....  $+30\text{ mA}$   
Port ON .....  $-50\text{ mA}$

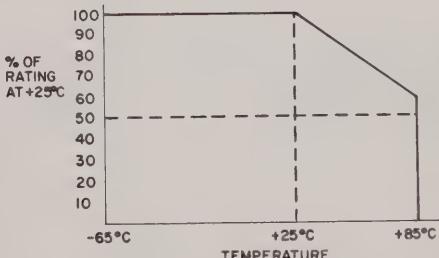


Fig. 1 Peak and average power derating factors

### ENVIRONMENTAL RATINGS

Temperature Range ..... Operating:  $-65^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ <sup>③</sup>  
Non-operating:  $-65^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

Humidity, Shock, etc. ..... Per MIL-STD-202C (See page 52 for details)

### DIMENSIONS & WEIGHTS

See page 52 for dimensional and weight data.

### AVAILABLE OPTIONS

#### Option No. Description

- 3 SMA female bias connector
- 4 Solder-type bias terminals
- 7 SMA male RF connectors
- 33 EMI filter bias terminals
- 35 High temperature design ( $+125^{\circ}\text{C}$  max.)

Other available options include units modified for closed-loop levelling applications. Additional information about special requirements can be obtained from the factory.

<sup>①</sup>The interval between the instant the rf power level in the port switched OFF drops to 90% of its original value and the instant the rf power level in the port switched ON rises to 90% of its final value.

<sup>②</sup>For operation of Models M871 and M873 with more than one port ON, total negative current should be limited to  $-150\text{ mA}$ . Do not apply more than  $75\text{ mA}$  to any OFF port or more than  $-75\text{ mA}$  to any ON port.

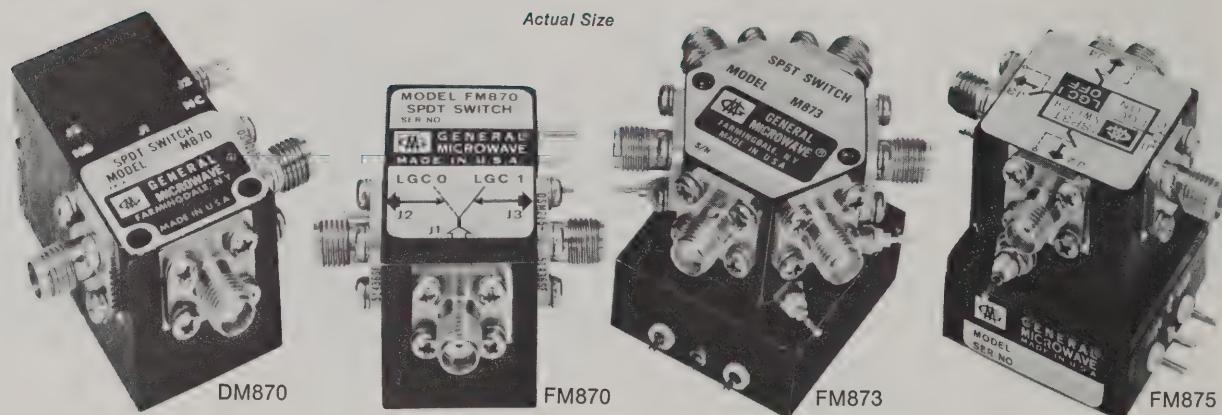
<sup>③</sup>High temperature models are available for operation to  $+125^{\circ}\text{C}$  on special order. See "AVAILABLE OPTIONS."



PIN Diode Control Devices

# Ultra-Broadband SPMT PIN Diode Switches With Integral Drivers

## Series DM87 and FM87



- **0.2 to 18 GHz frequency range**
- **Low VSWR and insertion loss**
- **Up to 60 dB isolation**
- **Small size, light weight**

The Series DM87\* and FM87\* are high performance broadband single-pole multi-throw switches with integral drivers. All models operate over the full instantaneous bandwidth of 0.2 to 18.0 GHz. FM87 models, which include switches with 2, 3, 4 or 5 positions, are powered by +5 and -12 volt supplies. DM87 switches, which are limited to SP2T and SP4T models, are powered by  $\pm$ 15 volt supplies. All models in both series feature an integrated circuit assembly of beam-lead and chip PIN diodes mounted in a thin-film microstrip transmission line as well as a patented bias line that contributes to the broadband low-loss performance.

### CONTROL OF SWITCH PORTS

The proper currents required to switch ports ON or OFF are provided by the drivers, which are controlled by logic signals applied by the user. In the 2-throw models DM870 and FM870, one of the two ports is biased ON and the other OFF at all times. In the DM870-22 and all 3, 4 and 5-throw models, the control terminals are individually available for each port.

### LOWER COST, REDUCED FREQUENCY MODELS

Each model in the Series DM87 and FM87 is also available at lower cost for operation over a reduced frequency range—from 0.2 to 12.4 GHz. Within this frequency range, all performance specifications are the same as for the broadband models. (To order these lower cost versions, add the prefix A to the model number. For example: Model ADM871)

### ALTERNATE CONFIGURATIONS

Page 29 describes the several options available, including: control input impedance; logic; rf and control connector selection; temperature range. In addition, all models in the Series DM87 and FM87 are also available without integral drivers—see pages 26-27 for full technical details.

\*Patent No. 3,812,438

## Specifications, Series DM87 and FM87

MODEL NO.	CHARACTERISTIC	FREQUENCY (GHz)			
		0.2 to 4.0	4.0 to 8.0	8.0 to 12.4	12.4 to 18.0
FM870, DM870 (SP2T)	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.5	55 1.5 1.75	55 1.75 1.75	55 2.2 2.0
FM875 (SP3T)	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.5	55 1.5 1.75	50 1.75 1.75	50 2.5 2.0
FM871, DM871 (SP4T)	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.5	55 1.5 1.75	50 2.0 1.75	50 2.5 2.0
FM873 (SP5T)	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.5	55 1.5 1.75	50 2.0 1.75	50 3.0 2.0

### PERFORMANCE CHARACTERISTICS

Switching Speed <sup>①</sup> .....	500 nanoseconds maximum.
Control Input Impedance .....	TTL compatible, two-unit load. (A unit load is 1.6 mA sink current and 40 $\mu$ A source current.)
Control Logic DM870 & FM870 .....	One port ON and one port OFF for logic "0" (-0.3 to +0.7 volt). Switching is accomplished by applying logic "1" (+2.5 to +5.0 volts). For independent port control, see "AVAILABLE OPTIONS."
DM871 .....	Logic "0" for port OFF and logic "1" for port ON.
FM875, FM871 & FM873 .....	Logic "0" for port ON and logic "1" for port OFF.

Power Supply Requirements	Vdc	mA	Vdc	mA
DM870 .....	+15, $\pm 5\%$	70	-15, $\pm 2\%$	90
DM871 .....	+15, $\pm 5\%$	170	-15, $\pm 2\%$	125
FM870 .....	+ 5, $\pm 2\%$	65	-12, $\pm 5\%$	55
FM875 .....	+ 5, $\pm 2\%$	125	-12, $\pm 5\%$	50
FM871 .....	+ 5, $\pm 2\%$	150	-12, $\pm 5\%$	50
FM873 .....	+ 5, $\pm 2\%$	190	-12, $\pm 5\%$	50

Power Handling Capability (from -65°C to +25°C;  
see power derating curve, Fig. 1, for higher temperatures).

Average Power .....

2W

Peak Power

(1  $\mu$ sec max. pulse width) .. 75W

### ENVIRONMENTAL RATINGS

Temperature Range .....

Operating: -65°C to +85°C<sup>②</sup>

Non-operating: -65°C to +125°C

Humidity, Shock, etc. .....

Per MIL-STD-202C (See page 52 for details)

### DIMENSIONS & WEIGHTS

See page 53 for dimensional and weight data.

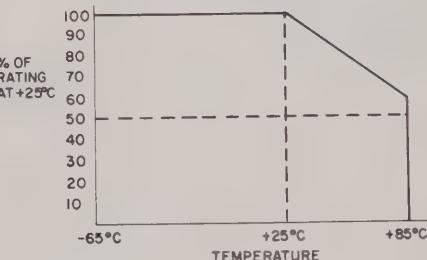


Fig. 1 Peak and average power derating factors

### AVAILABLE OPTIONS

Option No.	Description
4	Solder-type control terminals (Standard in FM models)
7	SMA male RF connectors
9	Inverse logic (logic "0" for port ON and logic "1" for port OFF—DM871 only)
20*	Two-unit load control input impedance
22	Individual port control (Model DM870 only)
35	High temperature design (+110°C, Series FM models only)

\* All models are furnished with this option unless otherwise specified by customer. Other options, such as 50 ohms to ground, are available on special order.

<sup>①</sup> The interval between the instant the rf power level in the port switched OFF drops to 90% of its original value and the instant the rf power level in the port switched ON rises to 90% of its final value.

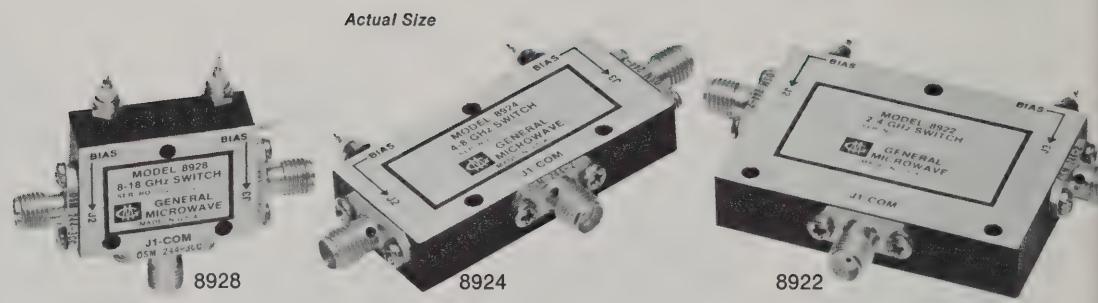
<sup>②</sup> Series FM87 models are available for operation to +110°C on special order. See "AVAILABLE OPTIONS."



PIN Diode Control Devices

# High-Speed SP2T PIN Diode Switches

## Series 892



- **S, C and X-U band models**
- **10ns switching speed**
- **Up to 60 dB isolation**
- **As low as 1.0 dB insertion loss**
- **4 W average power**
- **70 W peak power**

Series 892 high speed switches have been engineered to meet the need of microwave system designers for fast switching devices in small packages.

### 2 TO 18GHz FREQUENCY RANGE

Frequency coverage from 2 to 18GHz is provided by three models in the Series: Model 8922 (2-4 GHz), Model 8924 (4-8 GHz) and Model 8928 (8-18 GHz). Each model is capable of extended bandwidth operation, typically 3:1, with only moderate degradation in performance at the band edges, as shown in the specifications on page 31.

### FAST SWITCHING SHUNT DESIGN

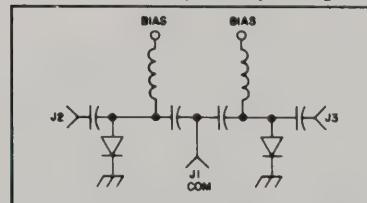
All models are optimally designed, with respect to their size, for low VSWR

and insertion loss. As shown in the schematic at the left, a pure shunt design is used for the most practical realization of fast switching action. Although the use of a pure shunt mode imposes certain bandwidth limitations, frequency coverage in excess of octave bands has been maintained.

By applying positive current to a bias terminal, the associated port is turned OFF since the corresponding diodes are forward biased to a low resistance. With negative voltage at a bias terminal, the high diode resistance of the back-biased state establishes the ON condition.

### ALTERNATE CONFIGURATIONS

Options for rf connector selection are described on page 31. In addition, Series 892 models are also available with integral drivers—see pages 32-33 for full technical details.



## Specifications, Series 892

MODEL NO.	FREQUENCY RANGE (GHz)	INSERTION LOSS, MAX. (dB)	ISOLATION, MIN. (dB)	VSWR, MAX. (ON position)
8922	2-4	1.0	60	1.5
	1.5-4.5	2.0	55	2.0
8924	4-8	1.4	50	1.5
	3-9	2.3	45	2.2
8928	8-18	2.3	50	2.2
	6-18	2.5	45	2.5

### PERFORMANCE CHARACTERISTICS

Switching Speed ① ..... 10 nanoseconds max.

Power Handling Capability ( $-65^{\circ}\text{C}$  to  $+25^{\circ}\text{C}$ ;  
see power derating curve, Fig. 1, for higher temperatures)

Average Power ..... 4W②

Peak Power (1  $\mu\text{sec}$ . max. pulse width) .. 70W

Bias Conditions (each port)

For Rated Isolation .....  $+25\text{ mA}$

For Rated Insertion Loss .....  $-12\text{V}$  to  $-15\text{V}$ ②

### ENVIRONMENTAL RATINGS

Temperature Range,

Operating and Non-Operating .....  $-65^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

Humidity, Shock, etc. ..... Per MIL-STD-202C (See page 52 for details)

### DIMENSIONS & WEIGHTS

See page 54 for dimensional and weight data

### RF CONNECTOR OPTIONS

Common (J1)	Output (J2 & J3)	Option No.
SMA Female	SMA Female	(Std.)
SMA Male	SMA Female	7A
SMA Female	SMA Male	7B

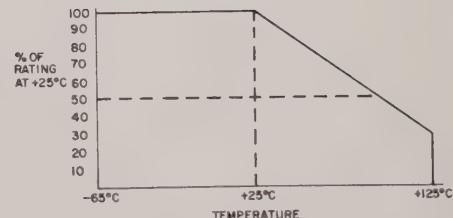


Fig. 1 Peak and average power derating factors

① Rise and fall times as measured between 10% and 90% of the output rf power level when switch is driven with shaped current pulse.

② Can be operated up to 10W average power with some increase in switching time when  $-30\text{V}$  power supply is used.

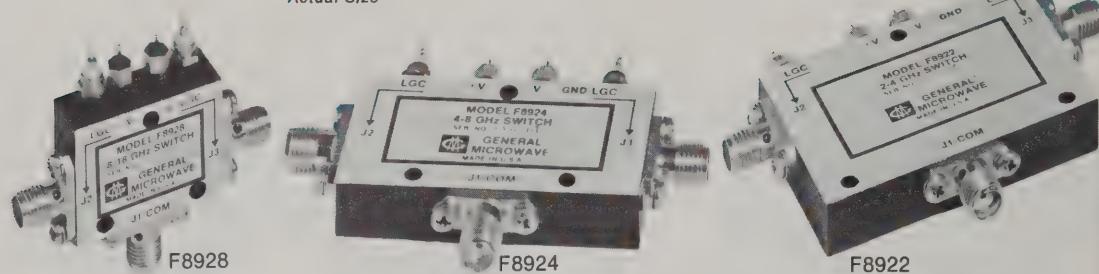


# High-Speed SP2T PIN Diode Switches With Integral Drivers

PIN Diode Control Devices

## Series F892

Actual Size



- **S, C and X-U band models**
- **10 ns switching speed**
- **Up to 60 dB isolation**
- **As low as 1.0 dB insertion loss**
- **4 W average power**
- **70 W peak power**

Series F892 high speed switches with integral drivers have been engineered to meet the need of microwave system designers for fast switching devices in small packages.

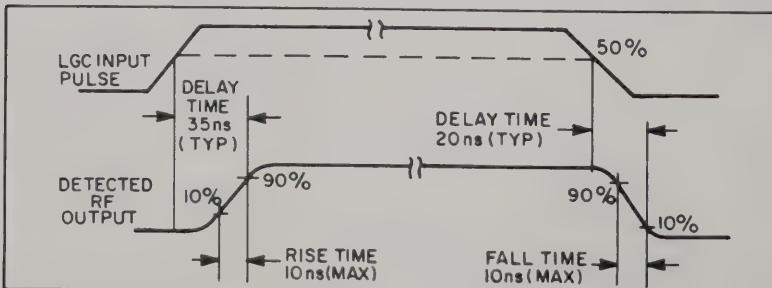
### 2 TO 18 GHz FREQUENCY RANGE

Frequency coverage from 2 to 18GHz is provided by three models in the Series: Model F8922 (2-4GHz), Model F8924 (4-8GHz) and Model F8928 (8-18GHz). Each model is capable of extended bandwidth operation, typically 3:1, with only moderate degradation in performance at the band edges, as shown in the specifications on page 33.

### FAST SWITCHING SHUNT DESIGN

All models are optimally designed, with respect to their size, for low VSWR and insertion loss. As shown in the schematic at the left, a pure shunt design is used for the most practical realization of fast switching action. Although the use of a pure shunt mode imposes certain bandwidth limitations, frequency coverage in excess of octave bands has been maintained.

The proper currents required to switch ports ON or OFF are provided by the integral drivers which are controlled by logic signals applied by the user. The switches are TTL-compatible. Switching characteristics are shown below.



### ALTERNATE CONFIGURATIONS

Options for rf connector selection and choice of control logic are described on page 33. In addition, all models are also available without integral drivers—see pages 30-31 for full technical details.

## Specifications, Series F892

MODEL NO.	FREQUENCY RANGE (GHz)	INSERTION LOSS, MAX. (dB)	ISOLATION, MIN. (dB)	VSWR, MAX. (ON position)
F8922	2-4	1.0	60	1.5
	1.5-4.5	2.0	55	2.0
F8924	4-8	1.4	50	1.5
	3-9	2.3	45	2.2
F8928	8-18	2.3	50	2.2
	6-18	2.5	45	2.5

### PERFORMANCE CHARACTERISTICS

Switching Speed<sup>①</sup> ..... 10 nanoseconds max.

Power Handling Capability (-65°C to +25°C;  
see power derating curve, Fig. 1, for higher temperatures)

Average Power ..... 4W<sup>②</sup>

Peak Power (1  $\mu$ sec. max. pulse width) .. 70W

Control Input Impedance ..... TTL compatible, two-unit load. (A unit load is 1.6 mA sink current and 40  $\mu$ A source current.)

Control Levels ..... -0.3 to + 0.7 volt (Logic "0")  
+ 2.5 to + 5.0 volts (Logic "1")

Power Supply Requirements ..... +5V  $\pm$ 2%, 125 mA  
-12V to -15V<sup>②</sup>, 2 mA

### ENVIRONMENTAL RATINGS

Temperature Range ..... Operating: -65°C to +110°C  
Non-operating: -65°C to +125°C

Humidity, Shock, etc. ..... Per MIL-STD-202C (See page 52 for details)

### DIMENSIONS & WEIGHTS

See page 54 for dimensional and weight data

### AVAILABLE OPTIONS

Control Functions

Control	J1 to J2		J1 to J3		Option No.
	ON	OFF	ON	OFF	
Independent Port (2 lines)	0	1	0	1	(Std.)
	1	0	1	0	9
One Port Toggle (1 line)	0	1	1	0	27

### RF Connectors

Common (J1)	Output (J2 & J3)	Option No.
SMA Female	SMA Female	(Std.)
SMA Male	SMA Female	7A
SMA Female	SMA Male	7B

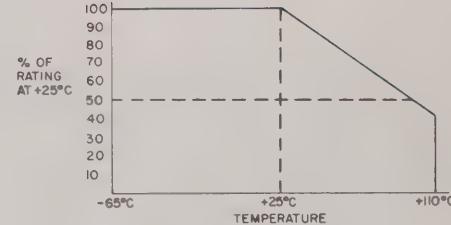


Fig. 1 Peak and average power derating factors

<sup>①</sup> Rise and fall times as measured between 10% and 90% of the output rf power level.

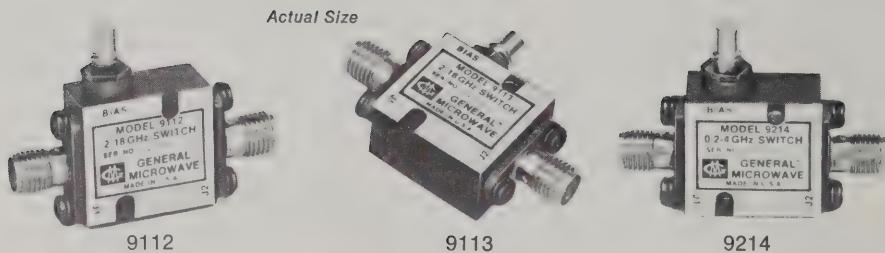
<sup>②</sup> Can be operated up to 10W average power with some increase in switching time when -30V power supply is used.



# Miniature SPST PIN Diode Switches

PIN Diode Control Devices

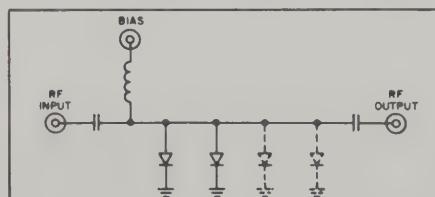
Series 91 and 92



- **2 to 18 GHz frequency range (Series 91)**
- **0.2 to 4 GHz frequency range (Series 92)**
- **Low VSWR and insertion loss**
- **Up to 80 dB isolation**
- **Less than 10 ns switching speed**
- **Miniature size, light weight**

Series 91 and Series 92 switches provide high performance characteristics over a multi-octave range. Series 91 models cover the frequency range of 2.0 to 18.0 GHz, while Series 92 models cover the range from 0.2 to 4.0 GHz. These miniature switches measure only 0.75x0.69x0.38 inches, and weigh only 0.39 oz.

Both series use an integrated circuit assembly of up to four chip PIN diodes mounted in a thin-film microstrip transmission line. The circuit configuration is shown at the left.



Application of a positive current to the bias terminal switches the unit OFF since the corresponding diodes are biased to a low resistance value. With zero or negative voltage at the bias terminal, the diodes are biased to high resistances and the unit is switched ON. Maximum ON to OFF and OFF to ON switching speeds are less than 10 ns.

## ALTERNATE CONFIGURATIONS

Options for rf and bias connector selection are described on page 35. In addition, all models are also available with integral drivers—see pages 36-37 for full technical details.

## Specifications, Series 91 and 92 (SPST)

MODEL NO.	CHARACTERISTIC	FREQUENCY (GHz)						
		0.2 to 0.5	0.5 to 1.0	1.0 to 4.0	2.0 to 4.0	4.0 to 8.0	8.0 to 12.4	12.4 to 18.0
9112	Min Isolation (dB)	—	—	—	38	45	45	45
	Max Insertion Loss (dB)	—	—	—	1.0	1.3	1.6	2.0
	Max VSWR (ON position)	—	—	—	1.3	1.6	1.75	1.75
9113	Min Isolation (dB)	—	—	—	50	63	63	63
	Max Insertion Loss (dB)	—	—	—	1.2	1.6	2.0	2.3
	Max VSWR (ON position)	—	—	—	1.4	1.75	1.75	1.85
9114	Min Isolation (dB)	—	—	—	65	80	80	78
	Max Insertion Loss (dB)	—	—	—	1.3	1.9	2.3	2.6
	Max VSWR (ON position)	—	—	—	1.4	1.75	1.75	2.2
9214	Min Isolation (dB)	40	45	50	—	—	—	—
	Max Insertion Loss (dB)	1.0	1.0	1.0	—	—	—	—
	Max VSWR (ON position)	1.5	1.5	1.5	—	—	—	—

### PERFORMANCE CHARACTERISTICS

Switching Speed<sup>①</sup> ..... <10 nanoseconds when driven by a shaped current pulse.

Power Handling Capability (from  $-65^{\circ}\text{C}$  to  $+25^{\circ}\text{C}$ ;  
see power derating curve, Fig. 1, for higher temperatures)

Average Power ..... 2W

Peak Power

(1  $\mu\text{sec}$ . max. pulse width) ..... 10W

Bias Conditions:	For Rated Isolation	For Rated Insertion Loss
Model 9112	+35 mA	-10V
Model 9113	+50 mA	-10V
Model 9114 and 9214	+70 mA	-10V

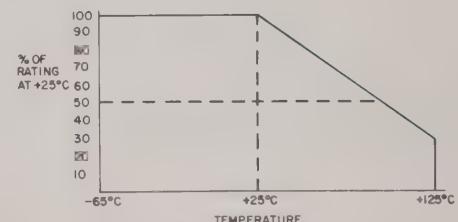


Fig. 1 Peak and average power derating factors

### ENVIRONMENTAL RATINGS

Temperature Range,  
Operating and Non-Operating ....  $-65^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

Humidity, Shock, etc. .... Per MIL-STD-202C (See page 52 for details)

### DIMENSIONS & WEIGHTS

See page 54 for dimensional and weight data.

### AVAILABLE OPTIONS

Option No.	Description
3	SMA female bias connector
4	Solder-type bias terminals
7	SMA male rf connectors
10	One SMA male and one SMA female rf connector
33	EMI filter bias terminals

<sup>①</sup>Switching speed is defined as the time interval between 10% and 90% of the output rf power level.

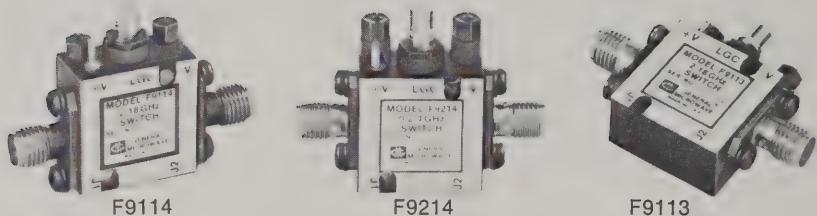


# Miniature SPST PIN Diode Switches With Integral Drivers

PIN Diode Control Devices

## Series F91 and F92

Actual Size



- **2 to 18 GHz frequency range (Series F91)**
- **0.2 to 4 GHz frequency range (Series F92)**
- **Low VSWR and insertion loss**
- **Up to 80 dB isolation**
- **Less than 10 ns switching speed**
- **Miniature size, light weight**

Series F91 and Series F92 switches with integral drivers provide high-performance characteristics over a multi-octave range. Series F91 models cover the frequency range of 2.0 to 18.0 GHz, while Series F92 models cover the range from 0.2 to 4.0 GHz. These miniature switches measure only 0.75x0.75x0.38 inches, and weigh only 0.43 oz.

Both series use an integrated circuit assembly of up to four chip PIN diodes mounted in a shunt configuration on a thin-film microstrip transmission line. The proper currents required to switch a unit ON or OFF are provided by the integral driver which requires +5, -12 volt power supplies and TTL-compatible logic control signals of either sense. Switching speed in either direction is less than 10ns.

### ALTERNATE CONFIGURATIONS

Options for rf connectors and driver logic are described on page 37. In addition, all models are also available without integral drivers—see pages 34-35 for full technical details.

## Specifications, Series F91 and F92

MODEL NO.	CHARACTERISTIC	FREQUENCY (GHz)						
		0.2 to 0.5	0.5 to 1.0	1.0 to 4.0	2.0 to 4.0	4.0 to 8.0	8.0 to 12.4	12.4 to 18.0
F9112	Min Isolation (dB)	—	—	—	38	45	45	45
	Max Insertion Loss (dB)	—	—	—	1.0	1.3	1.6	2.0
	Max VSWR (ON position)	—	—	—	1.3	1.6	1.75	1.75
F9113	Min Isolation (dB)	—	—	—	50	63	63	63
	Max Insertion Loss (dB)	—	—	—	1.2	1.6	2.0	2.3
	Max VSWR (ON position)	—	—	—	1.4	1.75	1.75	1.85
F9114	Min Isolation (dB)	—	—	—	65	80	80	78
	Max Insertion Loss (dB)	—	—	—	1.3	1.9	2.3	2.6
	Max VSWR (ON position)	—	—	—	1.4	1.75	1.75	2.2
F9214	Min Isolation (dB)	40	45	50	—	—	—	—
	Max Insertion Loss (dB)	1.0	1.0	1.0	—	—	—	—
	Max VSWR (ON position)	1.5	1.5	1.5	—	—	—	—

### PERFORMANCE CHARACTERISTICS

Switching Speed<sup>①</sup> ..... <10 nanoseconds

Control Input Impedance ..... TTL-compatible, two-unit load. (A unit load is 1.6 mA sink current and 40  $\mu$ A source current.)

Control Logic ..... Logic "0" for port ON and logic "1" for port OFF.

Power Supply Requirements ..... +5V  $\pm$  2%, 95 mA; -12V to -15V, 1 mA

Power Handling Capability (from -65°C to +25°C;  
see power derating curve, Fig. 1, for higher temperatures)

Average Power ..... 2W

Peak Power

(1  $\mu$ sec. max. pulse width) ..... 10W

### ENVIRONMENTAL RATINGS

Temperature Range ..... Operating: -65°C to +110°C  
Non-operating: -65°C to +125°C

Humidity, Shock, etc. ..... Per MIL-STD-202C (See page 52 for details)

### DIMENSIONS & WEIGHTS

See page 54 for dimensional and weight data

### AVAILABLE OPTIONS

#### Option No. Description

- 7 SMA male rf connectors
- 9 Inverse logic (logic "1" for port ON and logic "0" for port OFF)
- 10 One SMA male and one SMA female rf connector
- 33 EMI filter bias terminals

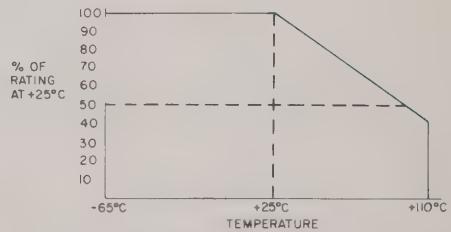


Fig. 1 Peak and average power derating factors

<sup>①</sup>Switching speed is defined as the time interval between 10% and 90% of the output rf power level.

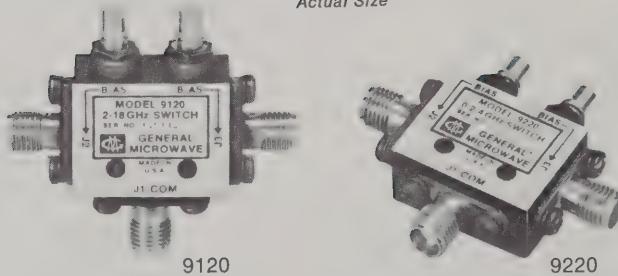


# Miniature SPMT PIN Diode Switches

PIN Diode Control Devices

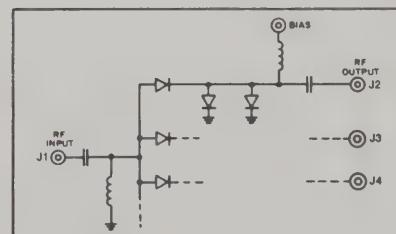
## Series 91 and 92

Actual Size



- **2 to 18 GHz frequency range (Series 91)**
- **0.2 to 4 GHz frequency range (Series 92)**
- **Low VSWR and insertion loss**
- **Up to 60 dB isolation**
- **Miniature size, light weight**

Series 91 and Series 92 switches provide high performance characteristics over a multi-octave frequency range. Series 91 models cover the frequency range of 2.0 to 18.0 GHz while Series 92 models cover the range of 0.2 to 4.0 GHz. 9120 and 9220 are SP2T switches measuring 0.87 x 0.69 x 0.38 inches. 9130 and 9230 are SP3T switches measuring 1.0 x 1.0 x 0.38 inches.



All models in both series use an integrated circuit assembly of series-shunt configuration beam-lead and chip PIN diodes mounted in a thin-film microstrip transmission line. The circuit configuration is shown at the left.

By applying positive current to a bias terminal, the associated port is OFF since

the corresponding shunt diodes are biased to a low resistance and the series diode to a high resistance. With negative current at the bias terminal, the converse conditions are established and the port is ON. Since bias terminals are individually available for each port, the user has the option of any combination of ports ON or OFF.

### ALTERNATE CONFIGURATIONS

Options for rf and bias connector selection are described on page 39. In addition, all models are also available with integral drivers—see pages 40-41 for full technical details.

## Specifications, Series 91 and 92

MODEL NO.	CHARACTERISTIC	FREQUENCY (GHz)				
		0.2 to 4.0	2.0 to 4.0	4.0 to 8.0	8.0 to 12.4	12.4 to 18.0
9120 (SP2T)	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	— — —	60 1.5 1.75	55 1.5 1.75	55 1.75 1.75	55 2.2 2.0
9130 (SP3T)	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	— — —	60 1.5 1.75	55 1.5 1.75	50 1.75 1.75	50 2.5 2.0
9220 (SP2T), 9230 (SP3T)	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.5	— — —	— — —	— — —	— — —

### PERFORMANCE CHARACTERISTICS

Switching Speed<sup>①</sup> ..... 500 nanoseconds maximum  
when driven by a shaped current pulse.

Power Handling Capability (from  $-65^{\circ}\text{C}$  to  $+25^{\circ}\text{C}$ ;  
see power derating curve, Fig. 1, for higher temperatures)

Average Power ..... 2W  
Peak Power  
(1  $\mu\text{sec}$ . max. pulse width) ..... 75W

Bias Current Required at Each Port for  
Rated Isolation and Insertion Loss

Port OFF .....  $+30\text{ mA}$   
Port ON .....  $-50\text{ mA}$ <sup>②</sup>

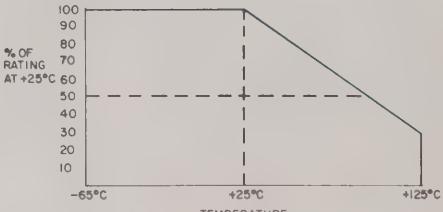


Fig. 1 Peak and average power derating factors

### ENVIRONMENTAL RATINGS

Temperature Range,  
Operating and Non-Operating .....  $-65^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$

Humidity, Shock, etc. ..... Per MIL-STD-202C (See page 52 for details)

### DIMENSIONS & WEIGHTS

See page 55 for dimensional and weight data.

### AVAILABLE OPTIONS

Option No.	Description
3	SMA female bias connector
4	Solder-type bias terminals
7	SMA male rf connectors
33	EMI filter bias terminals

Other available options include units modified for closed-loop levelling applications.  
Additional information about special requirements can be obtained from the factory.

<sup>①</sup> The interval between the instant the rf power level in the port switched OFF drops to 90% of its original value and the instant the rf power level in the port switched ON rises to 90% of its final value.

<sup>②</sup> For operation with more than one port ON, total negative current should be limited to  $-100\text{ mA}$ .

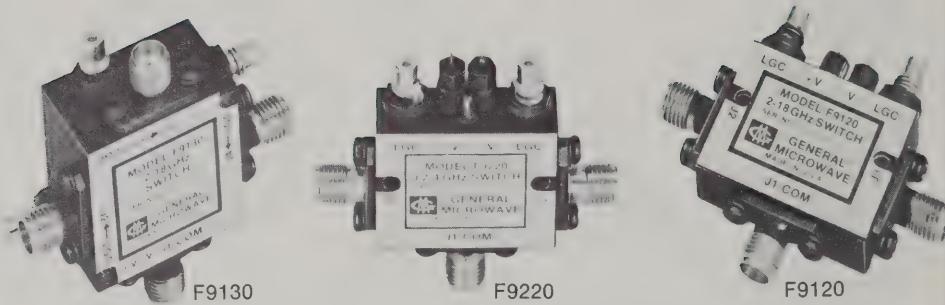


# Miniature SPMT PIN Diode Switches With Integral Drivers

PIN Diode Control Devices

## Series F91 and F92

Actual Size



- **2 to 18 GHz frequency range (Series F91)**
- **0.2 to 4 GHz frequency range (Series F92)**
- **Low VSWR and insertion loss**
- **Up to 60 dB isolation**
- **Miniature size, light weight**

Series F91 and Series F92 switches with integral drivers provide high performance characteristics over a multi-octave frequency range. Series F91 models cover the frequency range of 2.0 to 18.0GHz while Series F92 models cover the range of 0.2 to 4.0GHz.

All models in both series use an integrated circuit assembly of series-shunt configuration beam-lead and chip PIN diodes mounted in a thin-film microstrip transmission line. F9120 and F9220 are SP2T switches measuring 1.1 x 0.85 x 0.38 inches. F9130 and F9230 are SP3T switches measuring 1.0 x 1.0 x 0.75 inches.

The integral driver requires +5, -12 volt power supplies and TTL-compatible logic control signals of either sense. All models have independent port control.

### ALTERNATE CONFIGURATIONS

Options for logic, control and rf connector selection are described on page 41. An alternate package sizing for the SP2T models is available on special order as the Model F9121 or F9221. (See page 55 for dimensional data.) In addition, all models are also available without integral drivers—see pages 38-39 for full technical details.

## Specifications, Series F91 and F92

MODEL NO.	CHARACTERISTIC	FREQUENCY (GHz)				
		0.2 to 4.0	2.0 to 4.0	4.0 to 8.0	8.0 to 12.4	12.4 to 18.0
F9120 (SP2T)	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	— — —	60 1.5 1.75	55 1.5 1.75	55 1.75 1.75	55 2.2 2.0
F9130 (SP3T)	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	— — —	60 1.5 1.75	55 1.5 1.75	50 1.75 1.75	50 2.5 2.0
F9220 (SP2T), F9230 (SP3T)	Min Isolation (dB) Max Insertion Loss (dB) Max VSWR (ON position)	60 1.5 1.5	— — —	— — —	— — —	— — —

### PERFORMANCE CHARACTERISTICS

Switching Speed ① ..... 500 nanoseconds maximum.

Control Input Impedance ..... TTL-compatible, two-unit load. (A unit load is 1.6 mA sink current and 40  $\mu$ A source current.)

Control Logic ..... Logic "0" for port ON and logic "1" for port OFF.

Power Supply Requirements ②

+5V, $\pm 2\%$	—12V to —15V
F9120 and F9220 ..... 65 mA	50 mA
F9130 and F9230 ..... 125 mA	50 mA

Power Handling Capability (from —65°C to +25°C;  
see power derating curve, Fig. 1, for higher temperatures)

Average Power ..... 2W

Peak Power  
(1  $\mu$ sec. max. pulse width) ..... 75W

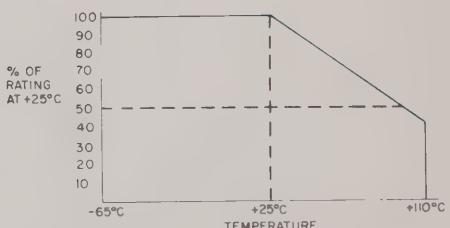


Fig. 1 Peak and average power derating factors

### ENVIRONMENTAL RATINGS

Temperature Range ..... Operating: —65°C to +110°C  
Non-operating: —65°C to +125°C

Humidity, Shock, etc. ..... Per MIL-STD-202C (See page 52 for details)

### DIMENSIONS & WEIGHTS

See page 55 for dimensional and weight data

### AVAILABLE OPTIONS

#### Option No. Description

- 3 SMA female bias terminals
- 4 Solder-type bias terminals
- 7 SMA male rf connectors
- 9 Inverse logic (logic "1" for port ON and logic "0" for port OFF) (for F9120 and F9220 only)
- 27 Single port (toggle) control
- 33 EMI filter bias terminals

① The interval between the instant the rf power level in the port switched OFF drops to 90% of its original value and the instant the rf power level in the port switched ON rises to 90% of its final value.

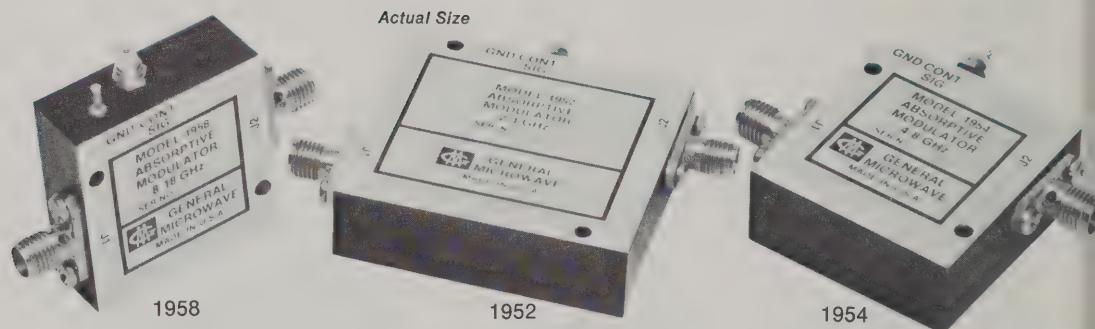
② For one port ON.



# Absorptive PIN Diode Modulators

PIN Diode Control Devices

## Series 195



- **S, C and X-U band models**
- **High performance special MIC quadrature hybrid design**
- **20 ns switching speed**
- **60 dB dynamic range**
- **2.0 max. VSWR**

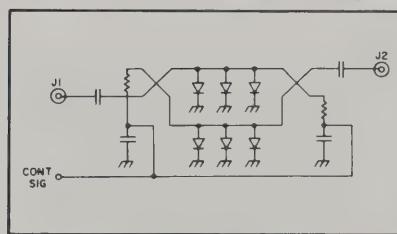
The Series 195 family of fast absorptive modulators are current-controlled PIN diode attenuators designed to provide small size and high performance at low cost. Their characteristics make them ideally suitable for a wide range of applications including level setting, amplitude modulation, pulse modulation and high speed switching.

### 2 TO 18GHz FREQUENCY RANGE

The three models in the Series 195 encompass a frequency range from 2 to 18GHz: Model 1952, from 2 to 4GHz; Model 1954, from 4 to 8GHz; and Model 1958, from 8 to 18GHz. Each model is capable of extended bandwidth operation, typically 3:1, with only moderate degradation in performance at the band edges, as shown in the specifications on page 43.

### UNIQUE QUADRATURE HYBRID DESIGN

The rf circuit uses two shunt arrays of PIN diodes and two quadrature



hybrid couplers as shown at the left. The hybrids are of a unique GMC microstrip design which readily integrates the hybrid with the diode array in order to yield a minimal package size. All models provide up to 60 dB of attenuation, with better than 20ns switching speeds when switching in either direction between insertion loss and max. attenuation level, when driven with an appropriately shaped current waveform.

### ALTERNATE CONFIGURATIONS

Options for rf and bias connector selection are described on page 43. In addition, Series 195 models are also available with integral drivers—see pages 44-45 for full technical details.

## Specifications, Series 195

MODEL NO.	FREQUENCY RANGE (GHz)	INSERTION LOSS, MAX. (dB)	VSWR, MAX.	MAXIMUM DEVIATION ( $\pm$ dB) FROM NOMINAL ATTENUATION AT:			
				10dB	20dB	40dB	60dB
1952	2-4	1.5	1.5	0.3	0.8	1.5	1.6
	1.5-4.5	1.8	2.0	0.5	1.4	3.0	3.5
1954	4-8	2.0	1.7	0.3	0.8	1.5	1.6
	3-9	2.2	2.2	0.5	1.4	3.0	3.5
1958	8-18	2.5①	1.8①	0.7	1.0	1.5	1.6
	6-18	2.5①	1.8①	0.9	1.5	3.0	3.5

### PERFORMANCE CHARACTERISTICS

Mid-Band Attenuation Range .....	60 dB min.
Switching Speed② .....	$\leq$ 20 nanoseconds
Power Handling Capability③ .....	100 mW average
Power Overload .....	1 W average, 70 W peak④
Bias Current .....	0 to +80 mA max. (See Fig. 1)

### ENVIRONMENTAL RATINGS

Temperature Range	
Operating and Non-Operating .....	-54°C to +125°C
Humidity, Shock, etc. .....	Per MIL-STD-202C (See page 52 for details)

### DIMENSIONS & WEIGHTS

See page 56 for dimensional and weight data

### AVAILABLE OPTIONS

Option No.	Description
3	SMA female bias connector
7	Two SMA male rf connectors
10	One SMA male and one SMA female rf connector
64	SMC bias connector

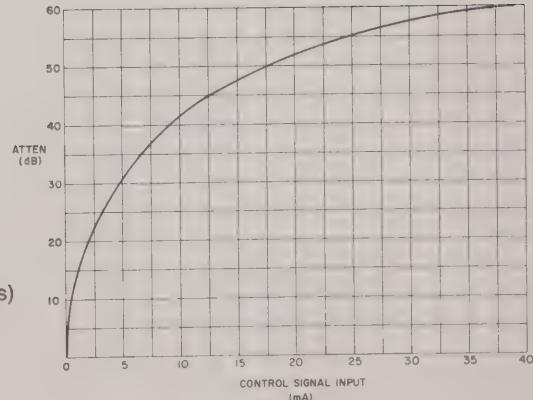


Fig. 1 Typical Curve of Attenuation vs. Bias Current

① Except from 16 to 18 GHz where insertion loss is 3.5 dB max. and VSWR is 2.0 max.

② In either direction between insertion loss and max. attenuation level, as measured from 10% to 90% of the rf power output.

③ Power rating is for continuous operation within specifications from -54°C to +125°C.

④ Max. pulse width 1  $\mu$ s at +25°C linearly degraded to 20 W, 1  $\mu$ s at +125°C.

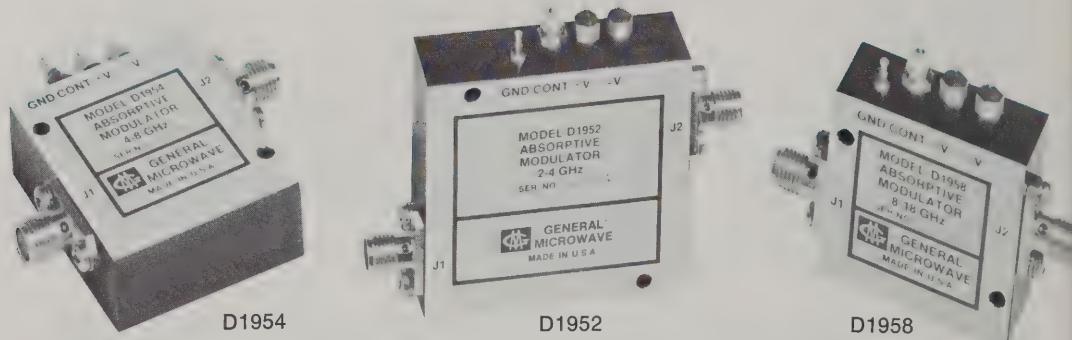


# Absorptive PIN Diode Modulators With Integral Drivers

## PIN Diode Control Devices

### Series D195

Actual Size



- **S, C and X-U band models**
- **High performance special MIC quadrature hybrid design**
- **10 ns switching speed**
- **60 dB dynamic range**
- **2.0 max. VSWR**

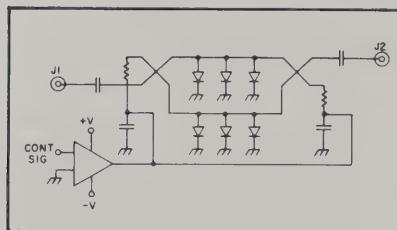
The Series D195 family of fast linear absorptive modulators with integral drivers are current-controlled PIN diode attenuators designed to provide small size and high performance at low cost. Their characteristics make them ideally suitable for a wide range of applications including level setting, amplitude modulation, pulse modulation and high speed switching.

#### 2 TO 18GHz FREQUENCY RANGE

Frequency coverage from 2 to 18GHz is provided by three models in the Series: Model D1952 (2-4 GHz), Model D1954 (4-8 GHz) and Model D1958 (8-18GHz). Each model is capable of extended bandwidth operation, typically 3:1, with only moderate degradation in performance at the band edges, as shown in the specifications on page 45.

#### UNIQUE QUADRATURE HYBRID DESIGN

The rf circuit uses two shunt arrays of PIN diodes and two quadrature



hybrid couplers as shown at the left. The hybrids are of a unique GMC microstrip design which readily integrates the hybrid with the diode array in order to yield a minimal package size. The integral driver provides voltage-controlled linear attenuation of 10dB per volt. All models provide up to 60dB of attenuation.

When switching in either direction between insertion loss and any attenuation level greater than 10dB, switching speed will vary, as a function of attenuation level, between 10 and 50ns. For small attenuation level changes at or near insertion loss, switching speed may approach 1  $\mu$ sec. Consult factory for technical information on alternate configuration with improved switching speed performance.

#### ALTERNATE CONFIGURATIONS

Options for rf connector selection, 20dB per volt transfer function and operation from  $\pm 15V$  power supply (in lieu of  $\pm 12V$ ) are described on page 45. In addition, all models are also available without integral drivers—see pages 42-43 for full technical details.

## Specifications, Series D195

MODEL NO.	FREQUENCY RANGE (GHz)	INSERTION LOSS, MAX. (dB)	VSWR, MAX.	MAXIMUM DEVIATION ( $\pm$ dB) FROM NOMINAL ATTENUATION AT:			
				10 dB	20 dB	40 dB	60 dB
D1952	2-4	1.5	1.5	0.3	0.8	1.5	1.6
	1.5-4.5	1.8	2.0	0.5	1.4	3.0	3.5
D1954	4-8	2.0	1.7	0.3	0.8	1.5	1.6
	3-9	2.2	2.2	0.5	1.4	3.0	3.5
D1958	8-18	2.5①	1.8①	0.7	1.0	1.5	1.6
	6-18	2.5①	1.8①	0.9	1.5	3.0	3.5

### PERFORMANCE CHARACTERISTICS

Mid-Band Attenuation Range .....	60 dB min.
Switching Speed② .....	$\leq$ 10 to 50 nanoseconds
Power Handling Capability ③ .....	100 mW average
Power Overload .....	1 W average, 70W peak④
Nominal Transfer Function .....	10 dB per volt
Linearity of Transfer Curve .....	See Fig. 1
Control Signal Input Voltage Range .....	0 to +6V
Control Signal Input Impedance .....	10 K ohms (nominal)
Power Supply Requirements .....	+12V at 100 mA (max.) -12V at 20 mA (max.)

### ENVIRONMENTAL RATINGS

Temperature Range, Operating and Non-Operating .....	-54°C to +110°C
Humidity, Shock, etc. ....	Per MIL-STD-202C (See page 52 for details)

### DIMENSIONS & WEIGHTS

See page 56 for dimensional and weight data

### AVAILABLE OPTIONS

Option No.	Description
7	Two SMA male rf connectors
10	One SMA male and one SMA female rf connector.
61	20 dB/volt transfer function with 0 to +3V control signal input.
62	$\pm$ 15 volts operation.
64	SMC bias connector

① Except from 16 to 18 GHz where insertion loss is 3.5 dB max. and VSWR is 2.0 max.

② In either direction between insertion loss and any attenuation level greater than 10 dB, as measured from 10% to 90% of the rf power output.

③ Power rating is for continuous operation within specifications from -54°C to +110°C.

④ Max. pulse width 1  $\mu$ s at +25°C linearly degraded to 20 W, 1  $\mu$ s at +110°C.

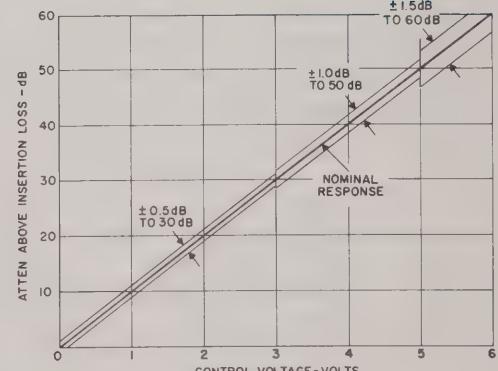


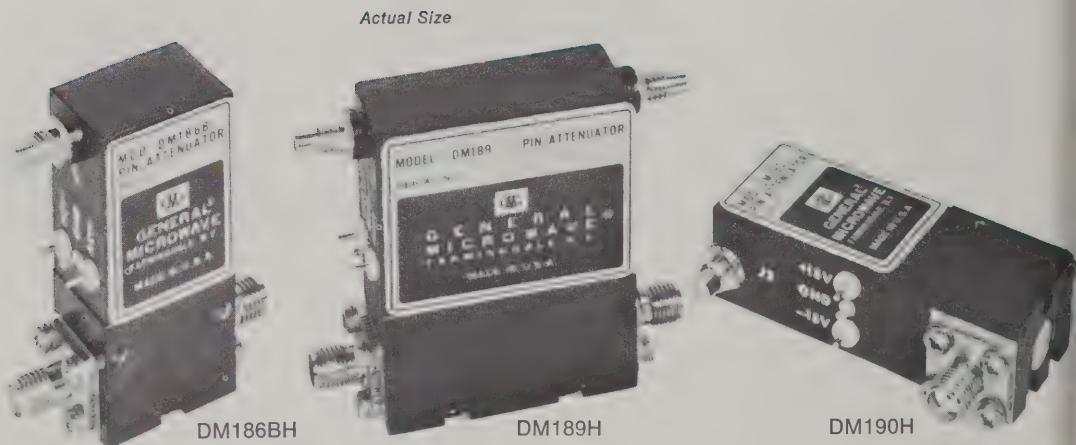
Fig. 1 Transfer Curve with Envelope of Typical Deviation



## PIN Diode Control Devices

# Absorptive High-Speed SPST PIN Diode Switches With Integral Drivers

Models DM186BH, DM189H and DM190H



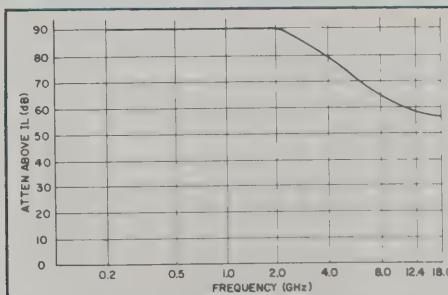
- **0.2 to 18 GHz frequency range**
- **Up to 65dB isolation**
- **Low VSWR and insertion loss**
- **Less than 20 nsec switching speed**
- **Small size, light weight**

Models DM186BH, DM189H and DM190H are high-speed broadband absorptive SPST PIN diode switches\* with integral drivers. Operating over the instantaneous frequency range from 0.2 to 18 GHz, they exhibit nominal isolation characteristics of 45, 65 and 35 dB, respectively. The rf design consists of a T-pad arrangement of shunt and series chip diodes in a microstrip integrated circuit transmission line, and a patented low-loss bias line.

### SWITCH CONTROL

The currents required to switch the units ON or OFF and to simultaneously maintain a bilateral 50-ohm impedance match at insertion loss and maximum isolation are provided by the integral drivers, which are controlled by logic signals applied by the user.

### HIGH-ISOLATION (REFLECTIVE) MODELS



These units are also available for operation as high-speed high-isolation reflective switches. Designated by Option 31, the reflective switches are intended for low-frequency applications where the isolation provided by the conventional shunt diode switch design (such as that used in the Series M86) is inadequate. A typical response curve of the Model DM186BH/31 is shown at the left.

### ALTERNATE CONFIGURATIONS

Options for rf and control connector selection as well as control input impedance and logic are described on page 47. In addition, these units are also available without integral drivers for use as continuously variable absorptive attenuators (see Models M186B, M189 and M190 on pages 48-49) or with digitally-programmable drivers for use as step attenuators (see Series 325 on pages 50-51.)

\* Patent Nos. 3,812,438 and 3,713,037

## Specifications, DM186BH, DM189H and DM190H

MODEL NO.	CHARACTERISTIC	FREQUENCY(GHz)		
		0.2 to 8.0	8.0 to 12.4	12.4 to 18.0
DM186BH	Dynamic Range (dB)	45①	45	40
	Max Insertion Loss (dB)	2.5	3.0	3.5
	VSWR (ON)	1.75	2.0	2.5
	VSWR (OFF)	1.5	1.5	1.75
DM189H	Dynamic Range (dB)	65	65	60
	Max Insertion Loss (dB)	2.7	4.0	6.0
	VSWR (ON)	1.75	2.0	2.5
	VSWR (OFF)	1.5	1.5	1.75
DM190H	Dynamic Range (dB)	35	30	30
	Max Insertion Loss (dB)	1.5	2.5	3.0
	VSWR (ON)	1.75	2.0	2.5
	VSWR (OFF)	1.5	1.5	1.75

① Except 40 dB from 0.2 to 2.0 GHz.

### PERFORMANCE CHARACTERISTICS

Switching Speed (Time interval between 10% and 90% of the output rf power level)

ON to OFF ..... 20 nsec. max.  
OFF to ON ..... 30 nsec. max.

Power Handling Capability (from -65°C to +25°C; see power derating curve Fig. 1, for higher temperatures)

Operating Power ..... 2 watts max. (peak or average)

Power Supply Requirements	+15Vdc, ±2%	-15Vdc, ±5%
DM186BH .....	30 mA	85 mA
DM189H .....	60 mA	170 mA
DM190H .....	30 mA	85 mA

Control Input Impedance .... TTL compatible, two-unit load. (A unit load is 1.6 mA sink current and 40  $\mu$ A source current.)

Control Logic .... Logic "0" (-0.3 to +0.7 volt) for switch OFF and logic "1" (+2.5 to +5.0 volts) for switch ON.

### ENVIRONMENTAL RATINGS

Temperature Range ..... Operating: -65°C to +85°C.

Non-operating: -65°C to +125°C

Humidity, Shock, etc. .... Per MIL-STD-202C (See page 52 for details)

### DIMENSIONS & WEIGHTS

See page 57 for dimensional and weight data.

### AVAILABLE OPTIONS

Option No.	Description
7	Two SMA male RF connectors
9	Inverse logic (logic "0" for switch ON and logic "1" for switch OFF)
10	One SMA male and one SMA female RF connector
20*	Two-unit load control input impedance
30	Solder-type control terminals
31	High isolation (reflective) design

\* All models are furnished with this option unless otherwise specified by customer. Other options, such as 50 ohms to ground, are available on special order.

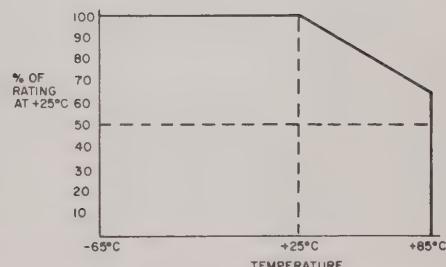


Fig. 1 Peak and average power derating factors



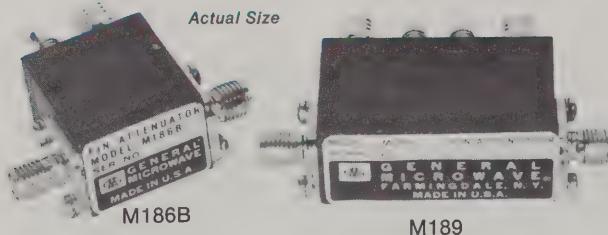
# Absorptive PIN Diode Attenuator/Modulators

## PIN Diode Control Devices

### Models M186B, M189, and M190

311 Driver

3/4 Actual Size



- 0.2 to 18 GHz frequency range
- Up to 65 dB attenuation range
- Low VSWR and insertion loss
- As low as  $\pm 0.5$  dB frequency sensitivity
- Small size, light weight

This family of absorptive PIN diode attenuator/modulators\* operates over the instantaneous frequency range from 0.2 to 18 GHz. Their multi-octave bandwidth makes them highly suitable for ECM equipment and wideband swept power, VSWR and attenuation measuring systems.

The rf design consists of an arrangement of shunt and series chip diodes in a microstrip integrated circuit transmission line, as shown in the schematic diagrams at the left.

The arrangement permits operation as a bilaterally-matched device at all attenuation levels by separately controlling the bias currents through the series and shunt diodes.

#### ATTENUATION LEVELS

The Models M190 and M186B are rated for attenuation levels up to 35 and 45 dB respectively. The Model M189, which consists of the equivalent of two independently-controlled M190 attenuators in a single rf assembly, is rated up to 65 dB. Models M189 and M190 are also available with digitally-programmable drivers under the designation of Series 325 (see pages 50-51 for full description).

#### POWER RATINGS

Although the three models safely tolerate input powers up to 2 watts from  $-65^{\circ}\text{C}$  to  $+25^{\circ}\text{C}$ , the maximum power level at which they operate within specifications is shown in Fig. 1. For higher power applications, narrower band LM186B, LM189 and LM190 models are available.

#### DRIVERS

The proper levels of series and shunt diode currents required for operation as a matched attenuator are provided by either the user's circuitry, or by the General Microwave Model 311 Driver. The Model 311 provides voltage controlled linear attenuation with a nominal transfer function of 10 dB per volt. One driver is required for each modulator except for Models M189 (or LM189) which require two drivers. When ordered with drivers, the driver/attenuator assembly is calibrated for optimum linearity at 2 GHz. Calibration at other frequencies within the band is available on special order.

#### FOR USE AS REFLECTIVE SWITCHES

By reducing the series diode current to zero, these units are operated as high-isolation reflective switches for low frequency applications where the isolation provided by the conventional shunt diode switch design (such as that used in the Series M86) is inadequate. A typical response curve of the Model M186B operating with no series diode current is shown in Fig. 2.

#### UNITS WITH INTEGRAL DRIVERS

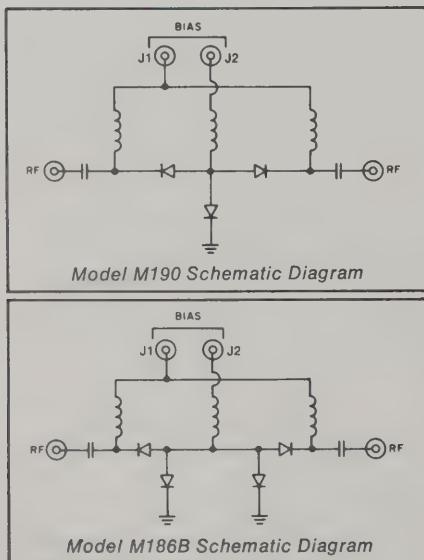
These units are also provided with integral drivers to function as high speed ON-OFF absorptive switches. (See pages 46-47)

#### ALTERNATE CONFIGURATIONS

Options for rf and bias connector selection, as well as higher operating temperature range, are described on page 49.

311 Driver

3/4 Actual Size



## Specifications, Models M186B, M189, and M190

MODEL NO.	CHARACTERISTIC	FREQUENCY (GHz)			MODEL NO.	CHARACTERISTIC	FREQUENCY (GHz)		
		0.2 to 8.0	8.0 to 12.4	12.4 to 18.0			0.2 to 8.0	8.0 to 12.4	
M186B	Max Insertion Loss (dB)	1.5	2.2	3.0	LM186B	Max Insertion Loss (dB)	1.5	2.6	
	Max VSWR	1.5	1.75	2.0		Max VSWR	1.5	1.75	
	Min Attenuation (dB)	45①	45	40		Min Attenuation (dB)	40②	40	
M189	Max Insertion Loss (dB)	2.5	3.0	5.0	LM189	Max Insertion Loss (dB)	2.5	3.5	
	Max VSWR	1.5	2.0	2.3		Max VSWR	1.5	2.0	
	Min Attenuation (dB)	65	65	60		Min Attenuation (dB)	65	60	
M190	Max Insertion Loss (dB)	1.5	1.8	2.5	LM190	Max Insertion Loss (dB)	1.5	1.8	
	Max VSWR	1.5	1.6	2.0		Max VSWR	1.5	1.75	
	Min Attenuation (dB)	35	35	30		Min Attenuation (dB)	35	30	

① Except 40 dB up to 2 GHz.

② Except 35 dB up to 2 GHz.

### ATTENUATION FLATNESS, $\pm$ dB Variations

ATTEN. (dB)	FREQUENCY (GHz)									
	0.2 to 8.0				0.2 to 12.4				12.4 to 18.0	
	M190	M189	LM190	LM189	M190	M189	LM190	LM189	M190	M189
10	0.5	0.5	0.5	0.5	0.7	0.7	0.7	0.7	1.0	1.0
20	0.5	0.5	0.5	0.5	1.0	1.0	1.2	1.2	1.0	1.0
30	0.7	0.7	1.0	1.0	1.5	1.5	2.0	2.0	1.0	1.5
40	—	1.0	—	1.0	—	1.5	—	2.0	—	1.5
50	—	1.0	—	1.5	—	1.5	—	2.0	—	1.5
60	—	1.0	—	2.0	—	1.5	—	2.5	—	1.5

### PERFORMANCE CHARACTERISTICS

Power Handling Capability (from  $-65^{\circ}\text{C}$  to  $+25^{\circ}\text{C}$ ;  
see power derating curve, Fig. 3, for higher temperatures)

M186B, M189, M190 ..... Operating, peak or average:  $-4$  to  $+20$  dBm (See Fig. 1)  
Max. safe, peak or average:  $+33$  dBm

LM186B, LM189, LM190 ..... Operating, peak or average:  $+20$  dBm  
Max. safe, peak or average:  $+33$  dBm

### Bias Current Requirements

M189, LM189 .....  $\pm 100$  mA max.  
M186B, LM186B, M190, LM190 ...  $\pm 50$  mA max.

### ENVIRONMENTAL SPECIFICATIONS (RF Unit)

Temperature Range ..... Operating:  $-65^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ③  
Non-operating:  $-65^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$   
Humidity, Shock, etc. ..... Per MIL-STD-202C (See page 52 for details)

### MODEL 311④ CHARACTERISTICS

Nominal Transfer Function	10 dB/volt
Linearity of Transfer Curve	$\pm 1$ dB from 5 dB above insertion loss at calibration frequency
Typical Small Signal Bandwidth	
M186B, M189, M190	500 kHz
LM186B, LM189, LM190	50 kHz
Control Signal Input Voltage Range	0 to $\pm 5$ volts dc
Control Signal Input Impedance	3K ohms (nominal)
Response Time	From 5 to 100 $\mu$ sec depending on attenuation change
Power Supply Requirements	$+15V \pm 0.1\%$ , 125 mA $-15V \pm 0.1\%$ , 125 mA
Temperature Range	Operating: $-55^{\circ}\text{C}$ to $+75^{\circ}\text{C}$ Non-operating: $-55^{\circ}\text{C}$ to $+85^{\circ}\text{C}$

### DIMENSIONS & WEIGHTS

See page 57 for dimensional and weight data (modulators)  
See page 57 for dimensional and weight data (driver)

③ Units are available for operation to  $+125^{\circ}\text{C}$  on special order. See "AVAILABLE OPTIONS".

④ Specifications listed are for each Model 311 Driver in use.

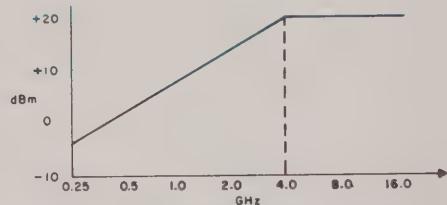


Fig. 1 Maximum Peak and Average Operating Power From  $-65^{\circ}\text{C}$  to  $+25^{\circ}\text{C}$

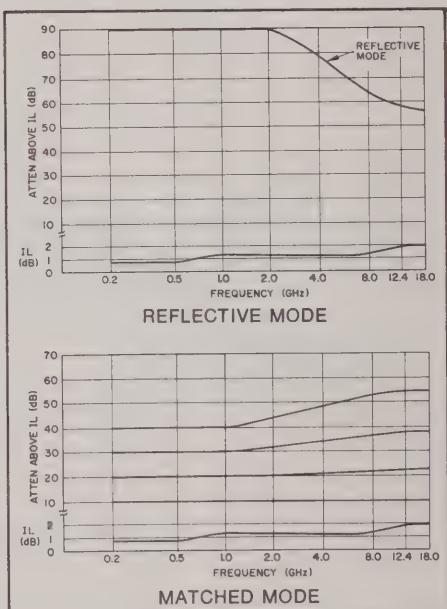


Fig. 2 Typical Response Curves of Model M186B

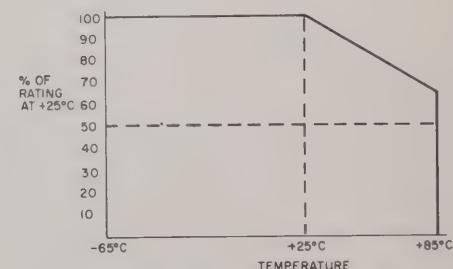


Fig. 3 Maximum Safe Power Derating Factors

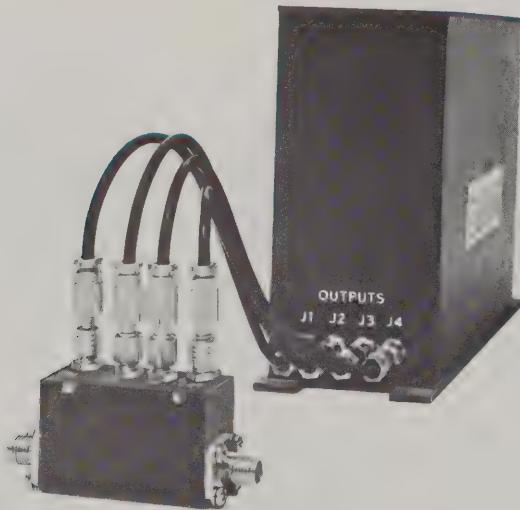
Option	Description
4	Solder-type bias terminals
7	Two SMA male rf connectors
10	One SMA male and one SMA female rf connector
33	EMI filter bias terminals
35	High-temperature design ( $+125^{\circ}\text{C}$ )



# Digitally Programmable PIN Diode Attenuators

## PIN Diode Control Devices

### Series 325



- **0.2 to 18 GHz frequency range**
- **Up to 120 dB attenuation range**
- **1 dB min. attenuation interval**
- **As low as  $\pm 0.5$  dB frequency sensitivity**
- **BCD, TTL-compatible logic**
- **5  $\mu$ sec. typical switching speed**

The Series 325 instrument-grade broadband programmable attenuators have evolved from the General Microwave family of M189 and M190 matched PIN diode attenuators described on pages 48-49. By employing a modular digitally-programmed driver, the Series 325 offers the user an attenuator characterized by the speed and reliability of the PIN diode and, in addition, a unique degree of flexibility that permits selection of dynamic range and attenuation intervals dedicated to individual application.

#### DESIGN VERSATILITY

Each Series 325 unit consists of an rf assembly and digital driver interconnected by coaxial cables. The rf assembly employs some combination of M189 and M190 attenuators chosen to meet the dynamic range and attenuation interval. By using multiple rf elements (the M189 has two independent elements and the M190 only one), a maximum overall design economy can be achieved in the trade-off between driver complexity and rf insertion loss.

#### PERFORMANCE CHARACTERISTICS

The rf performance of the Series 325, such as insertion loss, VSWR and frequency sensitivity, is determined by the characteristics of the M189 and M190 detailed on pages 48-49. On the other hand, such characteristics as temperature stability and repeatability depend upon the combined characteristics of rf assembly and driver.

#### DRIVER ASSEMBLY

The driver assembly for the Series 325 is housed in a metal enclosure which can be remotely located from the rf assembly by distances of up to 100 feet. Because each attenuation interval can be individually adjusted, unique attenuation programming can be achieved and recalibrated at periodic intervals against laboratory standards.

#### WIDE CHOICE OF STANDARD MODELS

To provide an indication of the capabilities of the Series 325, Table 1 lists a number of standard designs which can be provided. Requirements for variations from the models listed are invited.

*NOTE—All models listed include standard versions (0.2-18 GHz frequency range) of the M189 and/or M190 rf assembly. For higher power units (with 0.2-12.4 GHz frequency range), add suffix "L" to model number; e.g. 325L-30-1. For details of A and B driver dimensions, weights, connectors, etc. see page 58.*

Table 1—TYPICAL STANDARD MODELS, SERIES 325

Atten. Range, dB	Atten. Interval, dB	Model No.	Driver Config.	RF Assembly
0-10	1	325-10-1	A	M190
0-20	1	325-20-1	A	
	2	325-20-2	A	
0-30	1	325-30-1	B	
	10	325-30-10	A	
0-40	1	325-40-1	A	M189
	2	325-40-2	A	
	10	325-40-10	A	
0-60	1	325-60-1	B	One M189 Plus One M190
	6	325-60-6	A	
	10	325-60-10	A	
0-80	1	325-80-1	B	Two M189
	2	325-80-2	A	
0-100	2	325-100-2	B	
0-120	6	325-120-6	B	
	10	325-120-10	B	

\* Patent Nos. 3,812,438 and 3,713,037

## Specifications, Series 325

### RF ASSEMBLY

(See pages 48-49 for specification details of M189 and M190)

### DRIVER CHARACTERISTICS

Power Supply Requirements<sup>①</sup>... +15V at from 150 mA to 400 mA  
 -15V at from 150 mA to 450 mA  
 +5V at from 125 mA to 375 mA

Logic Input<sup>②</sup>..... Logic 0: -0.3 to 0.7V  
 Logic 1: 2.5 to 5.0V  
 Code: BCD

Dimensions and Weights ..... See page 58 for details on driver types A and B.

### OVERALL SPECIFICATIONS (Driver plus rf assembly)

Accuracy at Calibration Freq.<sup>③</sup>...  $\pm 0.2$  dB or 0.05 dB per 10 dB, whichever is greater.

Temperature Stability (0-65°C) ... 0 to 30 dB: 0.01 dB/°C  
 30 to 60 dB: 0.02 dB/°C

Power Supply Stability ..... 0.05 dB/% change in +15V supply  
 0.1 dB/% change in -15V supply

Switching Speed ..... From 3 to 20  $\mu$ sec. depending on model and attenuation change.

Operating Temperature Range ... 0°C to 65°C

Humidity, Shock, etc. ..... Per MIL-STD-202C (For rf assembly only. See page 52 for details)

### ACCESSORIES

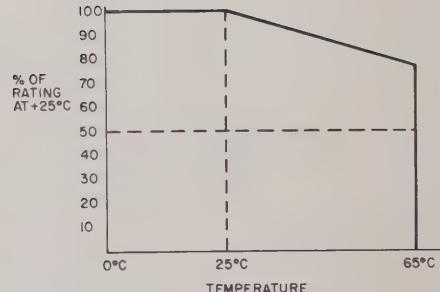
Accessories furnished include 1-ft. interconnecting cables (extra lengths available on special order) and mating power/logic connector.

### AVAILABLE OPTIONS

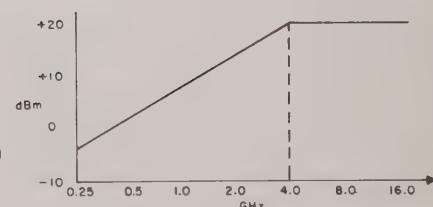
A number of standard rf assembly options exist, as described for the M189 and M190 on page 49. Additional information about special requirements can be obtained from the factory.

### ORDERING INFORMATION

To order a Series 325 Programmable Attenuator, consult Table 1 to determine if a standard model is available that meets your requirements. For models not listed or for other special requirements, please consult the factory.



Maximum Safe Power Derating Factors



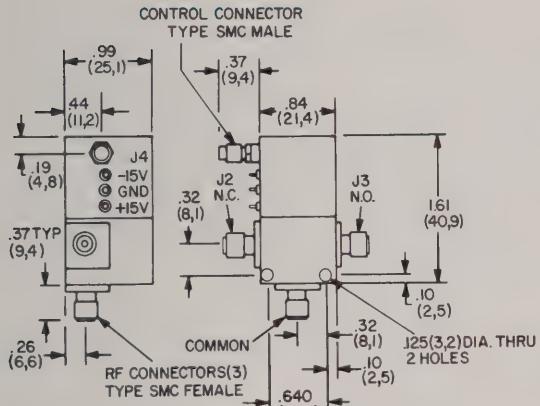
Maximum Peak and Average  
 Operating Power From 0°C to +25°C

<sup>①</sup>  $\pm 15V$ , +5V operation is standard. Units for  $\pm 12V$ , +5V operation are available on special order.

<sup>②</sup> Each logic line requires a source current of 3 mA and a sink current equivalent to three TTL loads.  
 Each line is inactive when its input is low, and is driven to its active condition with the application of a high control signal.

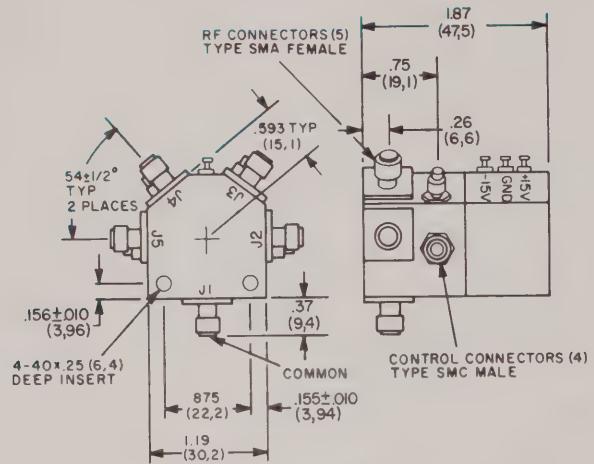
<sup>③</sup> All units are calibrated at 4 GHz. Calibration at other frequencies within the band is available upon request.





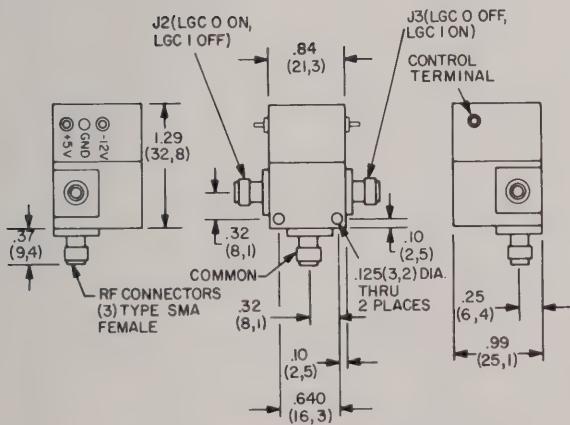
MODEL DM870

Approx. Wt.: 2.5 oz. (70 gm)



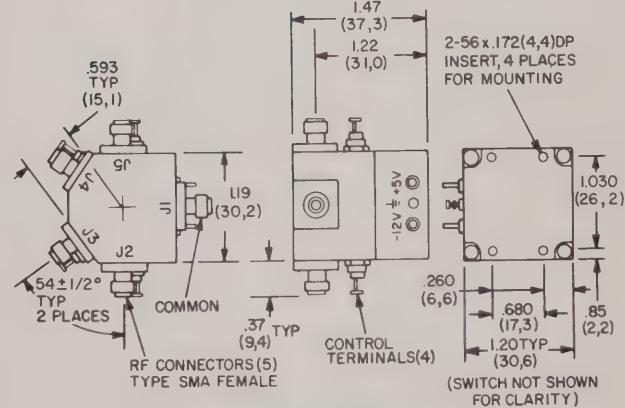
MODEL DM871

Approx. Wt.: 4.5 oz. (127 gm)



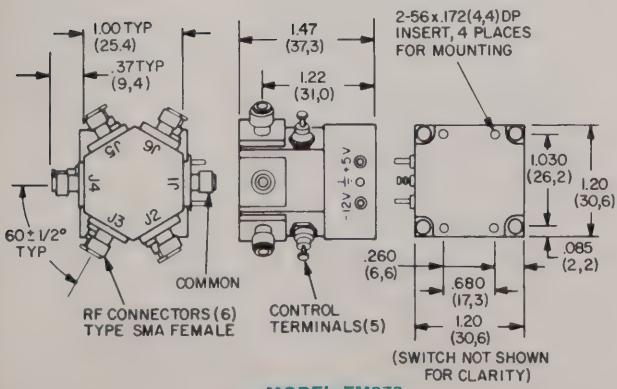
MODEL FM870

Approx. Wt.: 2.5 oz. (70 gm)



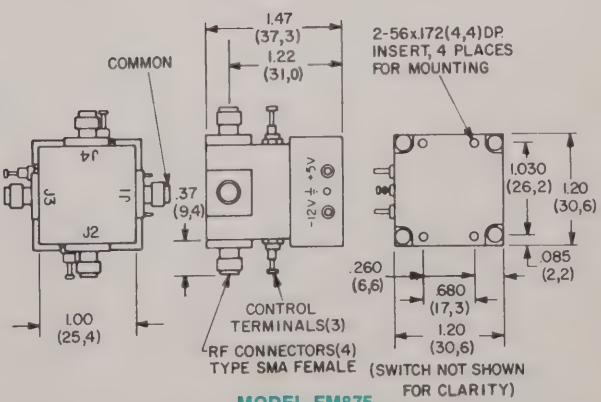
MODEL FM871

Approx. Wt.: 4 oz. (113 gm)



MODEL FM875

Approx. Wt.: 4 oz. (113 gm)



MODEL FM875

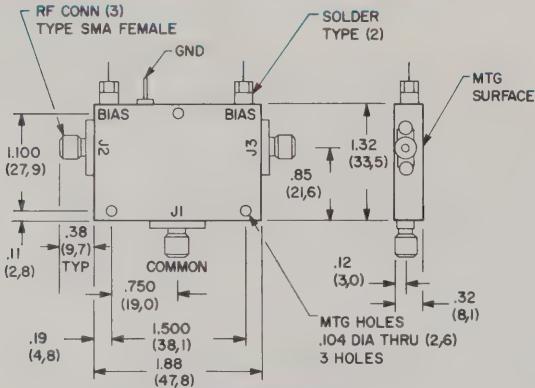
Approx. Wt.: 4 oz. (113 gm)



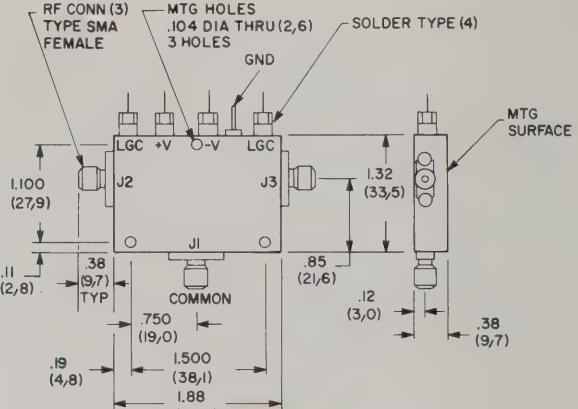
# Dimensions and Weights

## PIN Diode Control Devices

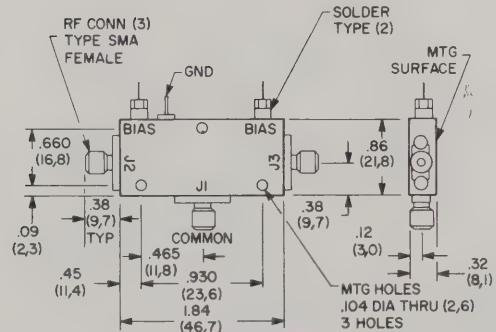
Dimensional Tolerances, unless otherwise indicated: .XX ±.02; .XXX ±.005



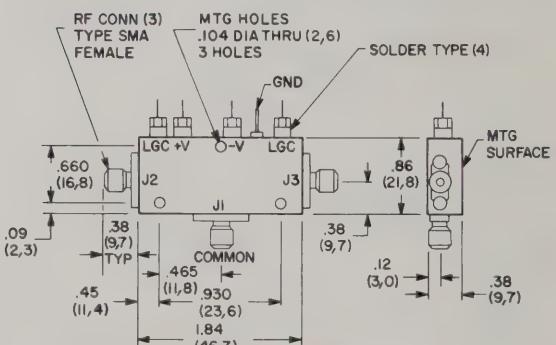
Approx. Wt.: 1.5 oz. (43 gm)



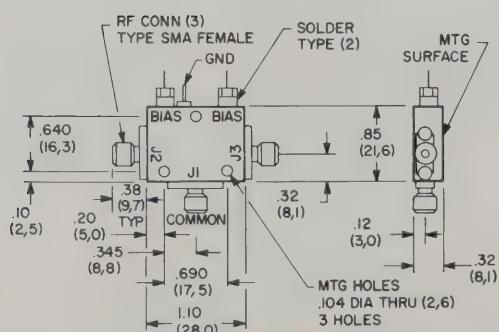
Approx. Wt.: 1.5 oz. (43 gm)



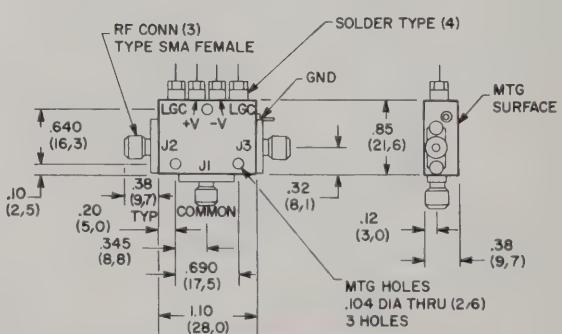
Approx. Wt.: 1 oz. (28 gm)



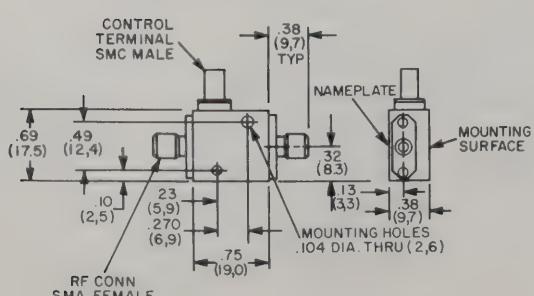
Approx. Wt.: 1 oz. (28 gm)



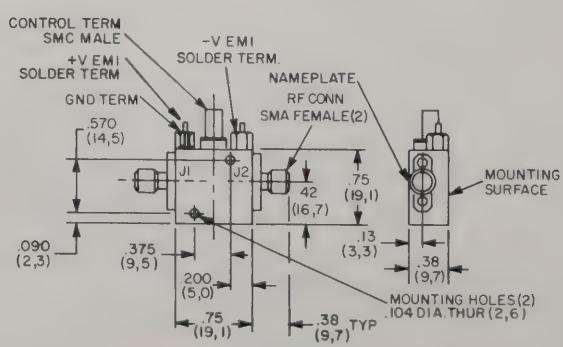
Approx. Wt.: 1 oz. (28 gm)



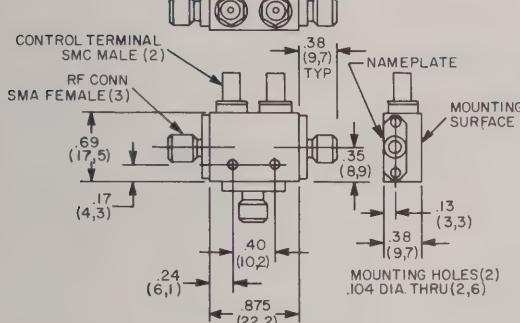
Approx. Wt.: 1 oz. (28 gm)



Approx. Wt.: .39 oz. (11 gm)

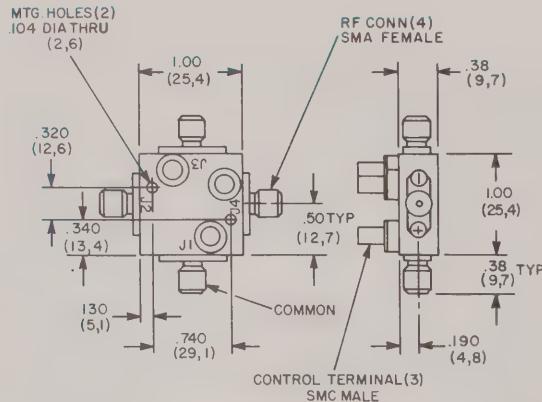


Approx. Wt.: .43 oz. (12 gm)



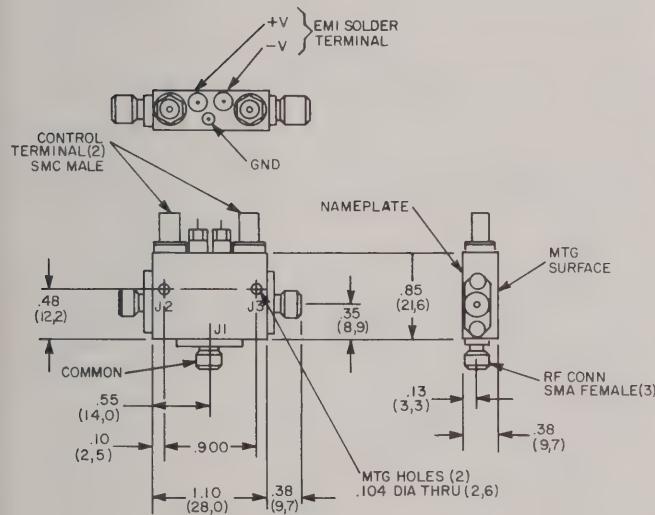
MODELS 9120, 9220

Approx. Wt.: .71 oz. (20 gm)



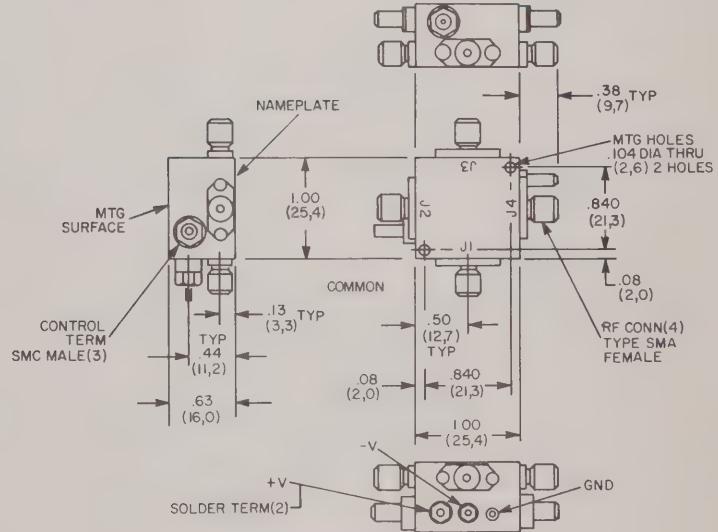
MODELS 9130, 9230

Approx. Wt.: 1 oz. (28 gm)



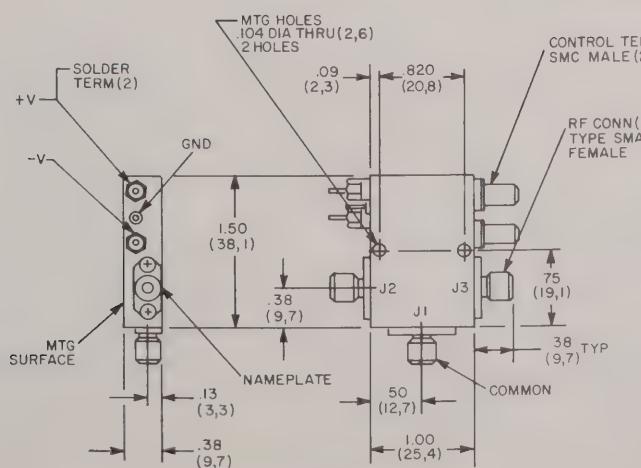
MODELS F9120, F9220

Approx. Wt.: .75 oz. (21 gm)



MODELS F9130, F9230

Approx. Wt.: 1.1 oz. (31 gm)



MODELS F9121, F9221

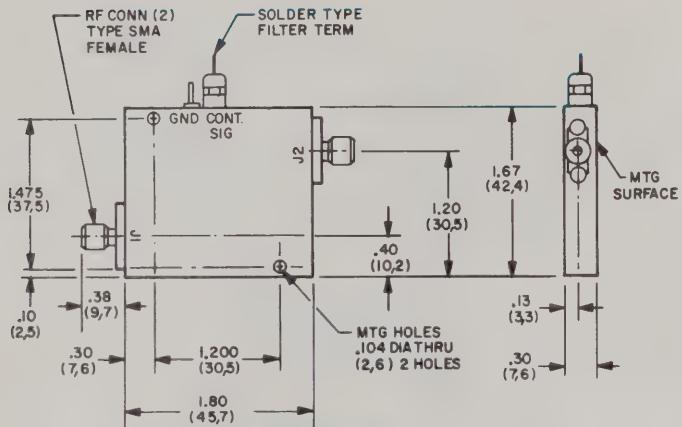
Approx. Wt.: 1 oz. (28 gm)



# Dimensions and Weights

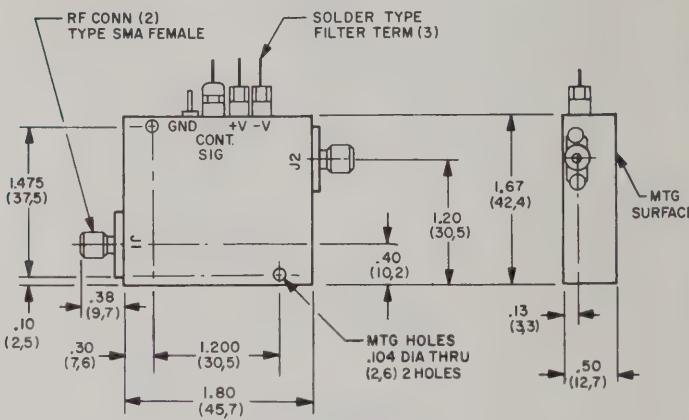
## PIN Diode Control Devices

Dimensional Tolerances, unless otherwise indicated: .XX ±.02; .XXX ±.005



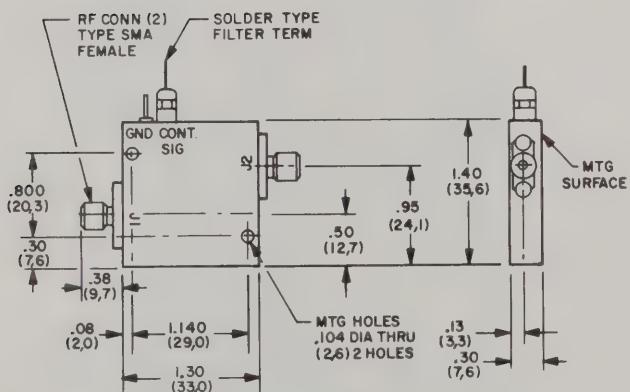
## MODEL 1952

Approx. Wt.: 2 oz. (56 gm)



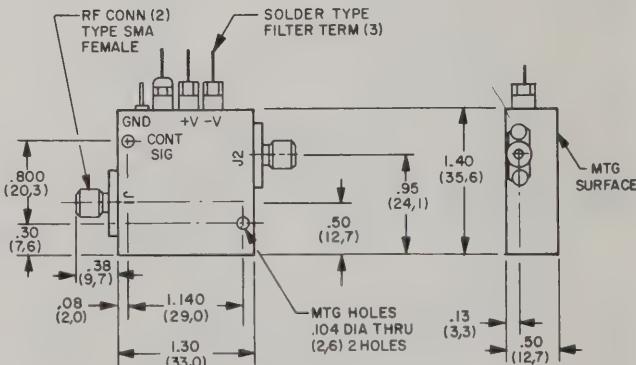
## MODEL D1952

Approx. Wt.: 2 oz. (56 gm)



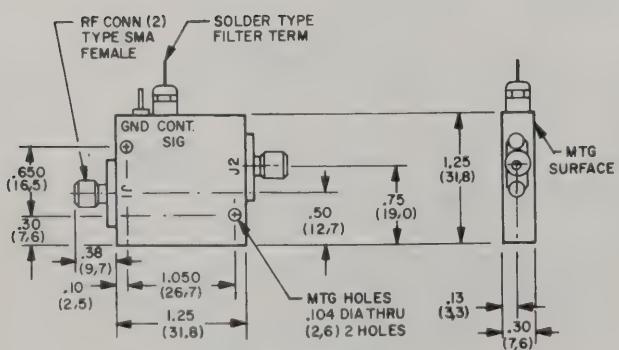
## MODEL 1954

Approx. Wt.: 1 oz. (28 gm)



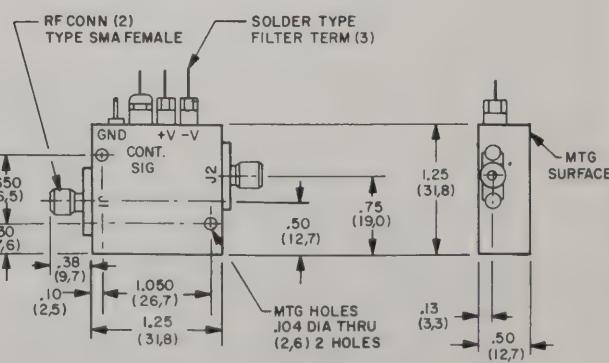
## MODEL D1954

Approx. Wt.: 1 oz. (28 gm)



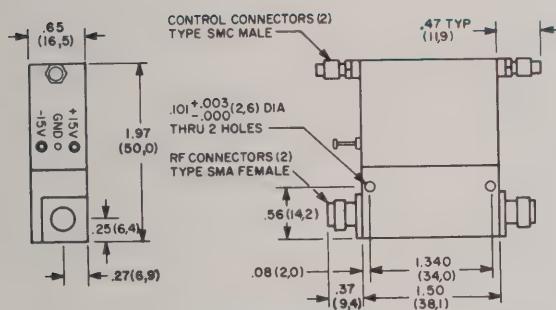
## MODEL 1958

Approx. Wt.: 1 oz. (28 gm)

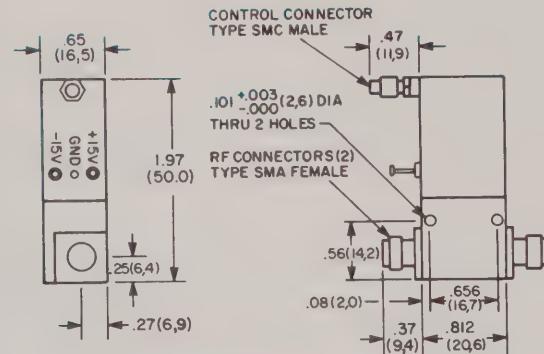


## MODEL D1958

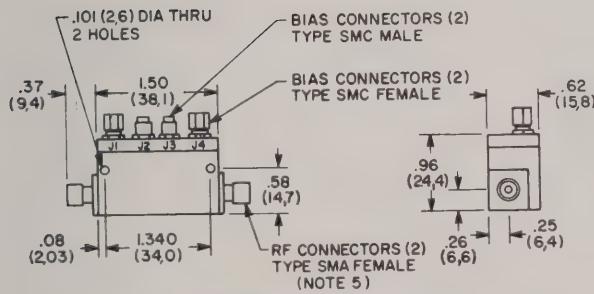
Approx. Wt.: 1 oz. (28 gm)



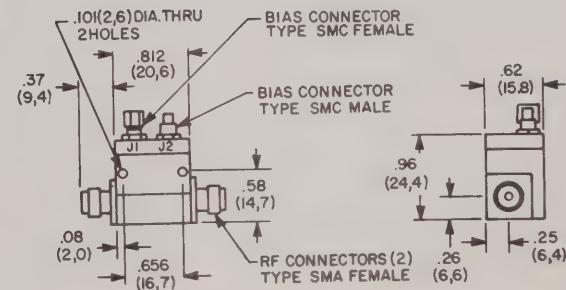
**MODEL DM189H**  
Approx. Wt.: 3 oz. (85 gm)



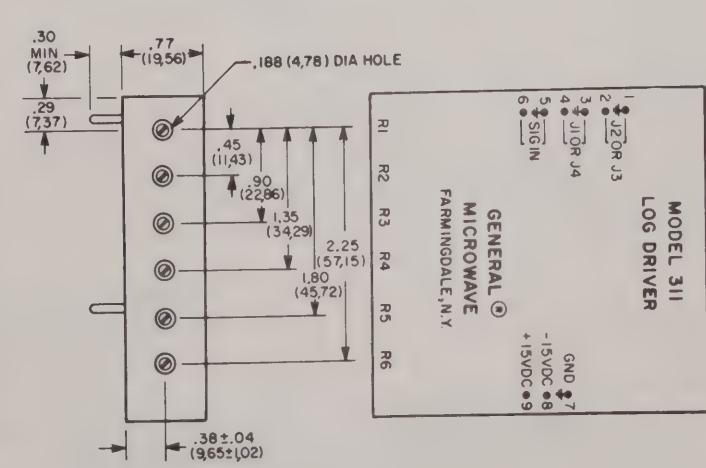
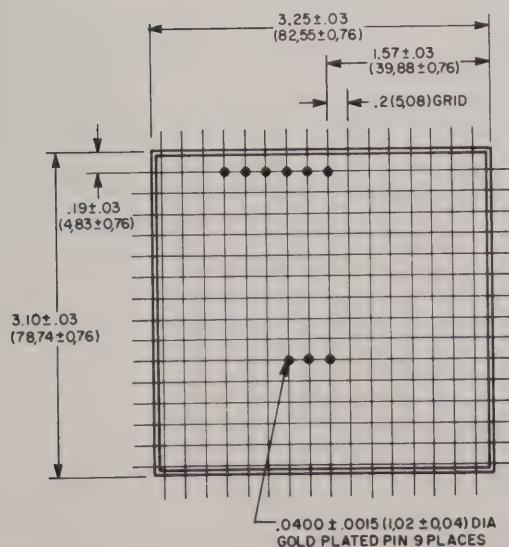
**MODELS DM186BH, DM190H**  
Approx. Wt.: 2 oz. (56 gm)



**MODELS M189 and LM189**  
Approx. Wt.: 2 oz. (56 gm)



**MODELS M186B and LM186B**  
**MODELS M190 and LM190**  
Approx. Wt.: 1 oz. (28 gm)



**MODEL 311 DRIVER**  
Approx Wt.: 4 oz. (113 gm)

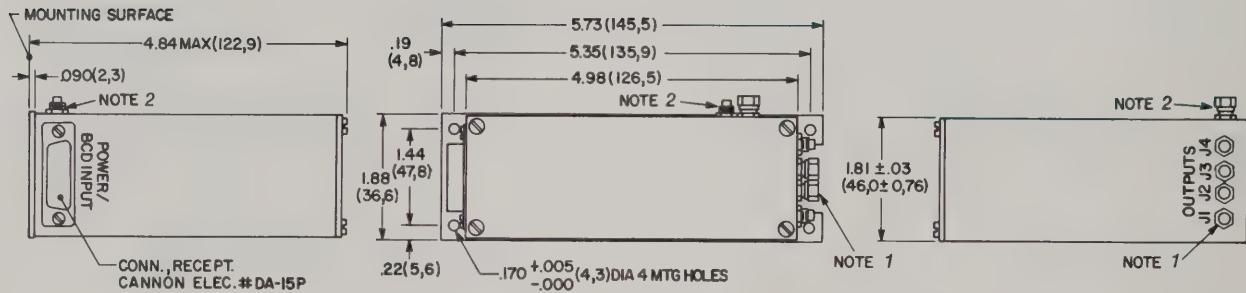


## PIN Diode Control Devices

# Dimensions and Weights

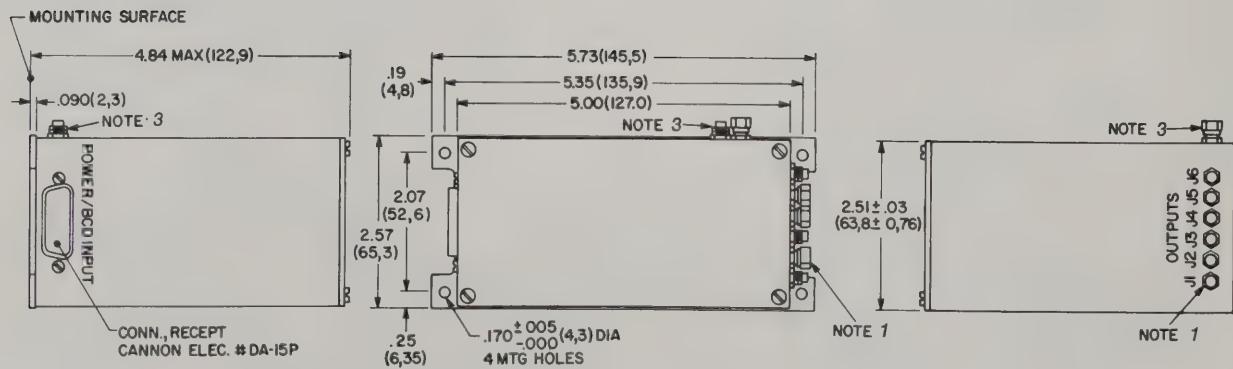
Dimensional Tolerances, unless otherwise indicated: .XX ± .02; .XXX ± .005

### MODEL 325 DRIVER ASSEMBLIES



#### DRIVER ASSEMBLY A

Approx. Wt.: 1.75 lbs. (795 gm)



#### DRIVER ASSEMBLY B

Approx. Wt.: 2 lbs. (909 gm)

1 Number of SMC bias connectors located in this area dependent on rf assembly (1 male and 1 female for M190 and/or 2 male and 2 female for each M189).

2 1 male and 1 female SMC bias connector added in this area for 325-80-2.

3 1 male and 1 female SMC bias connector added in this area for 325-100-2, 325-120-6 and 325-120-10.



# RAHAM™

## Radiation Hazard Meters

General Microwave RAHAM Radiation Hazard Meters detect and measure potentially hazardous electromagnetic energy radiating or leaking from rf and microwave sources. They are designed to monitor a wide variety of systems — military, industrial and commercial — where personnel may be exposed to such energy sources. Typical of these are: microwave ovens, medical equipment, radar installations, microwave heaters and dryers, mobile communication systems, electronic warfare systems.

### OSHA STANDARDS

The U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) has established occupational safety and health standards for the protection of personnel exposed to electromagnetic radiation.

Following are the applicable paragraphs of those standards, extracted from the Federal Register Volume 39, Number 125, June 27, 1974:

#### § 1910.97 NONIONIZING RADIATION

##### (1) Electromagnetic Radiation — Definitions

- (i) The term "electromagnetic radiation" is restricted to that portion of the spectrum commonly defined as the radio frequency region, which for the purpose of this specification shall include the microwave frequency region.
- (ii) *Partial body irradiation.* Pertains to the case in which part of the body is exposed to the incident electromagnetic energy.
- (iii) *Radiation protection guide.* Radiation level which should not be exceeded without careful consideration of the reasons for doing so.
- (v) *Whole body irradiation.* Pertains to the case in which the entire body is exposed to the incident electromagnetic energy or in which the cross section of the body is smaller than the cross section of the incident radiation beam.

##### (2) Radiation Protection Guide

- (i) For normal environmental conditions and for incident electromagnetic energy of frequencies from 10MHz to 100GHz, the radiation protection guide is 10mW./cm.<sup>2</sup> (milliwatt per square centimeter) as averaged over any possible 0.1-hour period. This means the following:

Power density: 10mW./cm.<sup>2</sup> for periods of 0.1-hour or more.

Energy density: 1mW.-hr./cm.<sup>2</sup> (milliwatt hour per square centimeter) during any 0.1-hour period.

This guide applies whether the radiation is continuous or intermittent.

- (ii) These formulated recommendations pertain to both whole body irradiation and partial body irradiation. Partial body irradiation must be included since it has been shown that some parts of the human body (e.g., eyes, testicles) may be harmed if exposed to incident radiation levels significantly in excess of the recommended levels.

### SELECTION GUIDE

RAHAM Model No.	Frequency Range, GHz	Description	Page No.
3	0.3 to 18	One meter, one probe, isotropic response	60
12	0.01 to 18	One meter, two plug-in probes, ultra-broadband coverage	62
1	0.3 to 18	One meter, one probe, high frequency	64
2	0.01 to 3	One meter, one probe, low frequency	64

*All models are furnished with carrying case and extension cable.*



## Radiation Hazard Meters

# RAHAM™ Isotropic Radiation Hazard Meter

## Model 3

- Isotropic response  $\pm 0.5$  dB
- 0.3 to 18 GHz frequency range
- $\pm 1$  dB frequency sensitivity
- 0.2 to 200 mW/cm<sup>2</sup> power range
- High overload protection
- Easy one-hand operation
- Measures rf and microwave leakage from:  
**COMMUNICATION SYSTEMS,  
RADAR SYSTEMS,  
ELECTRONIC  
WARFARE EQUIPMENT, ETC.**

The General Microwave Model 3\* Isotropic RAHAM portable battery-operated power density meter detects and measures potentially hazardous electromagnetic radiation emanating from rf and microwave CW, FM or pulsed energy sources, irrespective of the direction and polarization of the incident energy. The Model 3 features operation over the frequency range from 0.3 to 18GHz and over a power density range of 30dB. The instrument has three 10dB ranges with full scale readings of 2 mW/cm<sup>2</sup>, 20 mW/cm<sup>2</sup> and 200 mW/cm<sup>2</sup>.

The isotropic probe, Model 83, employs three orthogonally oriented thin-film thermocouple arrays. When the probe is irradiated, alternate junctions located within the rf field rise in temperature relative to adjacent thermally "sunked" junctions. By keeping the temperature differential small, the probe acts as a true square law (rms) detector producing a dc output voltage directly proportional to the absorbed radiation.

Wideband frequency performance and accurate near and far field power density measurements result from the design of the thermocouple array, which is equivalent to a thin-film resistive screen whose surface resistivity is high relative to free space impedance. This provides an almost-constant effective aperture to radiation fields ranging from UHF to K-band wavelengths such that frequency sensitivity over the operating band is held to within  $\pm 1$  dB.

The probe output is applied to a battery-powered, high-gain, low-noise, solid-state amplifier in an instrument case with a self-contained meter calibrated to read power density directly in milliwatts per square centimeter.



In addition to the power density meter and isotropic probe, a complete Model 3 includes a coiled extension cable and a carrying case. In normal use, the probe is mounted directly on the meter, allowing easy one-hand operation as shown. For remote operation—to reach awkward areas or to protect the user from exposure—the extension cable can be used between the probe and meter.

\*Patent No. 3,931,573

Meets the requirements specified for test equipment in the "IMPI Performance Standard on Leakage from Industrial Microwave Systems" dated August 1973 (International Microwave Power Institute)

## Specifications, Model 3 RAHAM

**NOTE—All units are factory-tested at 2.45 GHz to assure compliance with specifications.**  
 Individual unit calibration is available on special order at the following frequencies:  
 0.3, 0.5, 1.0, 2.4, 4.0, 8.0, 12.0 and 18.0 GHz.

Instrument Type .....	Power density meter; thermoelectric type; battery operated
Frequency Range .....	0.3 to 18.0 GHz
Power Ranges .....	Three 10 dB ranges with full-scale readings of 2 mW/cm <sup>2</sup> ; 20 mW/cm <sup>2</sup> ; 200 mW/cm <sup>2</sup>
Calibration Accuracy .....	±0.5 dB (at 2.45 GHz)
Instrumentation Accuracy .....	±3% fs
Frequency Sensitivity .....	±1 dB
Peak Power (max.) .....	30 watts/cm <sup>2</sup>
Pulse Energy .....	150 W-μsec
Average Power Overload <sup>①</sup> (@ 25°C) .....	0.5 watt/cm <sup>2</sup>
Isotropy .....	±0.5 dB for a plane wave of arbitrary incidence and polarization except where the polarization approaches the axis of the probe handle in which case it may rise as much as ±1.5 dB
Noise .....	Less than 1% peak-to-peak on most sensitive range
Approximate Response Time .....	1 second
Battery Operation .....	1000 hours (expendable)
Recorder Output .....	0.124 V full scale into a minimum resistance of 100 K ohms
Temperature Range .....	0°C to +50°C
Dimensions:	
Power Density Meter .....	2.50" x 1.63" x 6.38" (64 x 41 x 162 mm)
Probe .....	13.25" long x 2.75" max. dia. (336 x 70 mm)
Cable Assembly .....	4' long (122 cm)
Carrying Case .....	13.50" x 10.00" x 4.15" (343 x 254 x 105 mm)
Approx. Weight .....	3.25 lbs. (1,58 kg)

<sup>①</sup> While the unit will take this overload for short periods of time, extended periods of operation at this level, or exceeding this rating, may result in permanent change in its thin-film element characteristics or even burnout. Maximum care should be exercised to avoid this occurrence.



## Radiation Hazard Meters

# RAHAM™ Broadband Radiation Hazard Meter

## Model 12

- **Ultra-broadband**
- **.01 to 18 GHz frequency range**
- **0.2 to 200 mW/cm<sup>2</sup> power range**
- **Measures linear and circularly polarized signals**
- **Low noise and drift**
- **Small, light, portable, for easy one-hand operation**
- **Measures rf and microwave leakage from:**  
**MICROWAVE OVENS, MEDICAL EQUIPMENT, HEATERS & DRYERS, COMMUNICATION SYSTEMS, RADAR SYSTEMS, ELECTRONIC WARFARE SYSTEMS**

The Model 12\* RAHAM is a portable battery-operated power density meter especially designed to detect and measure potentially hazardous electromagnetic radiation emanating from rf and microwave energy sources. It features two interchangeable plug-in probes which provide operation over the frequency ranges from .01 to 3 GHz and 0.3 to 18 GHz. Three 10dB power ranges provide a choice of full-scale readings of 2, 20 or 200 mW/cm<sup>2</sup>.

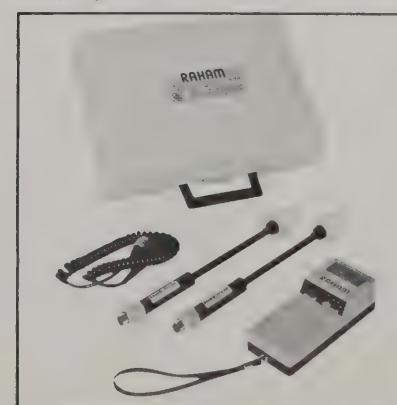
The operating frequency range is dependent on which of the two probes are in use. The Model 81 probe, for 0.3 to 18 GHz coverage, employs two orthogonally oriented thin-film thermocouple arrays. These arrays, which contain a number of series connected thermal junctions, are mounted between a pair of special high thermal conductivity, low loss dielectric wafers which simultaneously enhance the sensitivity and reduce drift. When the probe is irradiated, alternate junctions located within the rf field rise in temperature relative to adjacent thermally "sunked" junctions. By keeping the temperature differential small, the RAHAM probe acts as a true square law (rms) detector, producing a dc output voltage directly proportional to the absorbed radiation.

Wideband frequency performance and accurate near and far field power density measurements result from the design of the thermocouple array, which is equivalent to a thin-film resistive screen whose surface resistivity is high relative to free space impedance. This provides almost constant effective aperture to radiation fields ranging from UHF to K-Band wavelengths.

The Model 82 probe, used for lower frequencies from .01 to 3 GHz, utilizes two short crossed dipoles each feeding a Schottky barrier diode. The diode impedance in the specified frequency range is largely characterized by its barrier capacity. This capacitance is in series with that of the short dipole whose coupling action to free space is also essentially represented by an equivalent capacitance. For as long as total circuit reactance is large relative to free space impedance, a condition which sets the upper frequency limit, the induced voltage for constant power density remains constant with frequency. As a consequence of the capacitive divider network, the induced voltage across the diode is constant and the probe's output is flat with frequency. The lower frequency limit is reached when the barrier capacitive reactance becomes comparable to the barrier resistance. For the Model 82 probe, that condition is reached below 0.01 GHz.

The output from either probe is applied to a high-gain, low-noise, solid-state amplifier in an instrument case with a self-contained meter calibrated to read power density directly in milliwatts per square centimeter. A convenient wrist-loop carrying strap is attached at the base of the power density meter.

In addition to the power density meter and two probes, a complete Model 12 includes a coiled extension cable and a carrying case. In normal use, either one of the probes is mounted directly on the meter, allowing easy one-hand operation as shown. For remote operation—to reach awkward areas or to protect the user from exposure—the extension cable can be used between the probe and meter.



Meets the requirements specified for test equipment in the "IMPI Performance Standard on Leakage from Industrial Microwave Systems" dated August 1973 (International Microwave Power Institute)

\* Patent No. 3,931,573

## Specifications, Model 12 RAHAM

**NOTE—All units are factory-tested at 2.45 GHz to assure compliance with specifications.**

*Individual unit calibration is available on special order at the following frequencies:  
0.01, 0.05, 0.1, 0.3, 0.5, 1.0, 2.4, 4.0, 8.0, 12.0 and 18.0 GHz.*

Instrument Type .....	Power density meter; battery operated
Frequency Ranges .....	.01 to 3.0 GHz and 0.3 to 18.0 GHz
Power Ranges .....	Three 10 dB ranges with full-scale readings of 2 mW/cm <sup>2</sup> ; 20 mW/cm <sup>2</sup> ; 200 mW/cm <sup>2</sup>
Calibration Accuracy .....	±0.5 dB (at 2.45 GHz)
Frequency Sensitivity:	
From 0.01 to 3 GHz .....	±1.0 dB
From 0.3 to 1 GHz .....	-1.0 to -4.0 dB
From 1 to 18 GHz .....	±1.5 dB
Power Characteristics:	
With Model 81 Probe .....	Peak power 30 W/cm <sup>2</sup> ; pulse energy 150 W-μsec Power overload ① 0.5 W/cm <sup>2</sup> average
With Model 82 Probe .....	Peak power 30 W/cm <sup>2</sup> ; pulse energy 150 W-μsec Power overload 1.0 W/cm <sup>2</sup> average
Polarization .....	Elliptical, measures linear and circularly polarized signals
Noise .....	Less than 1% peak-to-peak on most sensitive range
Approximate Response Time .....	1 second
Battery Operation .....	1000 hours (expendable)
Recorder Output .....	0.124 V full scale into a minimum resistance of 100 K ohms
Temperature Range .....	0°C to +50°C
Dimensions:	
Power Density Meter .....	2.50" x 1.63" x 6.38" (64 x 41 x 162mm)
Probe .....	12.75" long x 1.50" max. dia. (324 x 38 mm)
Cable Assembly .....	4' long (122cm)
Carrying Case .....	13.50" x 10.00" x 4.15" (343 x 254 x 105mm)
Approx. Weight .....	3.25 lbs. (1.58 kg)

① While the unit will take this overload for short periods of time, extended periods of operation at this level, or exceeding this rating, may result in permanent change in its thin-film element characteristics or even burnout. Maximum care should be exercised to avoid this occurrence.

### OTHER MODELS AVAILABLE

For applications where the ultra-broadband frequency coverage of the Model 12 is not required, a choice of RAHAM Models 1 and 2 is available (see page 64).



# RAHAM™

## Radiation Hazard Meters

### Radiation Hazard Meters

**Model 1      Model 2**  
**0.3 to 18 GHz      0.01 to 3 GHz**

- **0.2 to 200 mW/cm<sup>2</sup> power range**
- **Measures linear and circularly polarized signals**
- **Low noise and drift**
- **Small, light, portable, for easy one-hand operation**
- **Measures rf and microwave leakage from: MICROWAVE OVENS, MEDICAL EQUIPMENT, HEATERS & DRYERS, COMMUNICATION SYSTEMS, RADAR SYSTEMS, ELECTRONIC WARFARE SYSTEMS**



RAHAM Models 1\* and 2 are portable battery-operated power density meters for the detection and measurement of potentially hazardous electromagnetic radiation emanating from rf and microwave energy sources. Their general description and operation is the same as the Model 12 (see page 62) except that only one probe each is supplied with the Model 1 and Model 2.

The Model 1, with a frequency range from 0.3 to 18 GHz, has a probe with two orthogonally oriented thin-film thermocouple arrays. (Identical to the Model 81 probe described in detail on page 62.)

The Model 2, designed for lower frequency coverage from .01 to 3 GHz, utilizes a probe with two short crossed dipoles each feeding a Schottky barrier diode. (Identical to the Model 82 probe described in detail on page 62.)

**NOTE—All units are factory-tested at 2.45 GHz to assure compliance with specifications.**  
 Individual unit calibration is available on special order at the following frequencies:  
 Model 1: 0.3, 0.5, 1.0, 2.4, 4.0, 8.0, 12.0 and 18.0 GHz.  
 Model 2: 0.01, 0.05, 0.1, .3, 0.5, 1.0 and 2.4 GHz.

SPECIFICATIONS	MODEL 1	MODEL 2
Frequency Range	0.3 to 18.0 GHz	0.01 to 3.0 GHz
Frequency Sensitivity	± 1.5 dB (from 0.3 to 1 GHz) -1.0 to -4.0 dB (from 1 to 18 GHz)	± 1 dB (from 0.01 to 3 GHz)
Power Characteristics	Peak power 30W/cm <sup>2</sup> ; pulse energy 150W-μsec. Power overload ① 0.5W/cm <sup>2</sup> average	Peak power 30W/cm <sup>2</sup> ; pulse energy 150W-μsec. Power overload 1.0W/cm <sup>2</sup> average
Power Ranges	Three 10 dB ranges with full-scale readings of 2 mW/cm <sup>2</sup> ; 20 mW/cm <sup>2</sup> ; 200 mW/cm <sup>2</sup>	
Calibration Accuracy	± 0.5 dB (at 2.45 GHz)	
Polarization	Measures linear and circularly polarized signals	
Noise	Less than 1% peak-to-peak on most sensitive range	
Approximate Response Time	1 second	
Battery Operation	1000 hours (expendable)	
Recorder Output	0.124V full scale into a min. resistance of 100 K ohms	
Temperature Range	0°C to +55°C	
Dimensions: Power Density Meter Probe Cable Assembly Carrying Case	2.50" x 1.63" x 6.38" (64x41x162mm) 12.75" long x 1.50" max. dia. (324 x 38 mm) 4' long (122cm) 13.50" x 10.00" x 4.15" (343x254x105mm)	
Approx. Weight	3.25 lbs. (1.58 kg)	

① While the unit will take this overload for short periods of time, extended periods of operation at this level, or exceeding this rating, may result in permanent change in its thin-film element characteristics or even burnout. Maximum care should be exercised to avoid this occurrence.

Meets the requirements specified for test equipment in the "IMPI Performance Standard on Leakage from Industrial Microwave Systems" dated August 1973 (International Microwave Power Institute)



# Solid State Microwave Signal Sources

Advances in transistor and Gunn diode technology permit more convenient and lower cost generation of microwave power by solid state devices than by their vacuum tube counterparts. The General Microwave Series 520 includes three transistor and four Gunn diode sources which cover the range of 0.4 to 4 GHz and 4 to 18 GHz, respectively.



## SELECTION GUIDE

Model No.	Frequency Range, GHz	rf Power Output, mW	
		Typical	Minimum
520	0.4 to 1.2	150	50
521	0.85 to 2.15	50	10
522	2.0 to 4.0	30	10
523	4.0 to 8.0	20	10
523-1	4.5 to 8.5	20	10
524	8.0 to 12.5	40	20
525	12.0 to 18.0	20	5

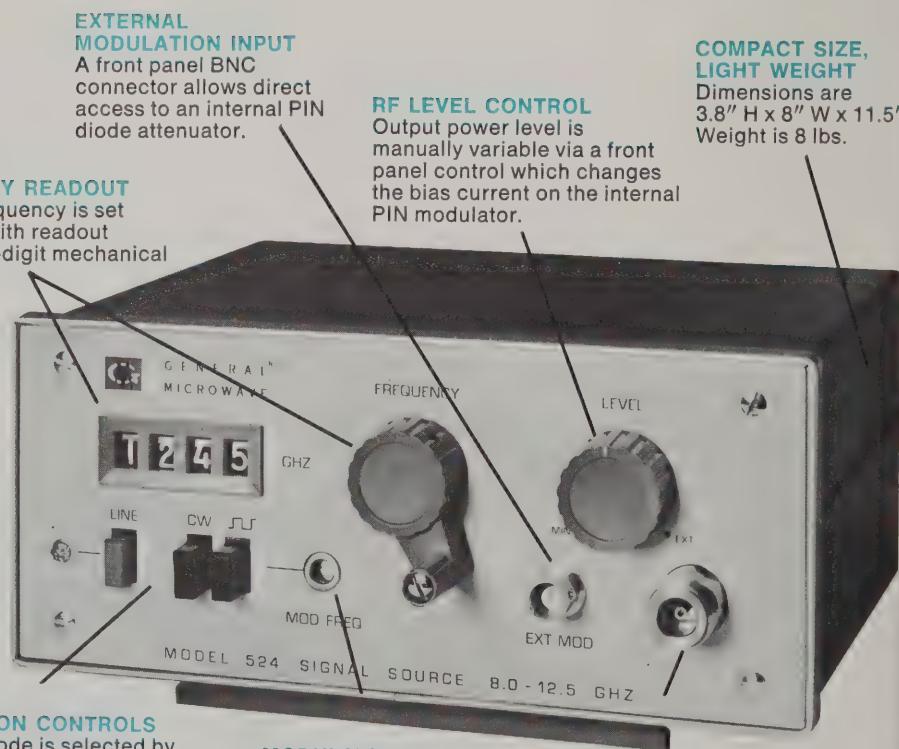


# Solid State Microwave Signal Sources

## Microwave Signal Sources

### Series 520

- 0.4 to 18 GHz frequency range
- Transistor and Gunn diode sources
- $\pm 1\%$  readout accuracy
- Small size
- Easy to use, push-button controls



**EXTERNAL MODULATION INPUT**  
A front panel BNC connector allows direct access to an internal PIN diode attenuator.

**4-DIGIT FREQUENCY READOUT**  
Desired frequency is set manually, with readout shown on 4-digit mechanical counter.

**RF LEVEL CONTROL**  
Output power level is manually variable via a front panel control which changes the bias current on the internal PIN modulator.

**COMPACT SIZE, LIGHT WEIGHT**  
Dimensions are 3.8" H x 8" W x 11.5" D.  
Weight is 8 lbs.

**PUSH-BUTTON CONTROLS**  
Operating mode is selected by easy-to-use push-button controls. "LINE" activates AC power, with panel lamp indicating power ON. For CW output, "CW" button is depressed. For square-wave modulated output, button marked "S" is pushed.

**MODULATING FREQUENCY CONTROL**  
Screwdriver adjustment sets internal modulation frequency between 900 to 1100 Hz or 2.9 to 3.1 kHz (depending on internal connection).

**RF OUTPUT**  
The rf output is brought out to a front panel type N connector via a miniature ferrite isolator, PIN diode modulator and low-pass filter. A rear panel BNC connector provides an output voltage directly proportional to frequency.

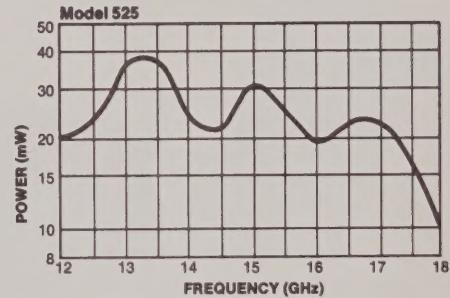
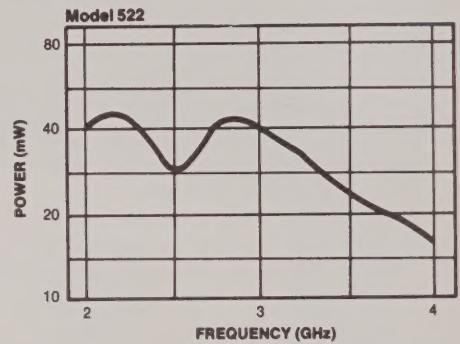
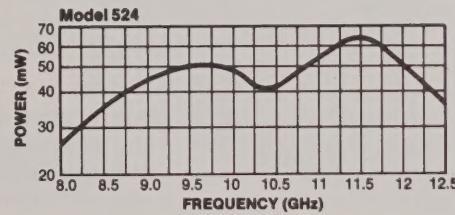
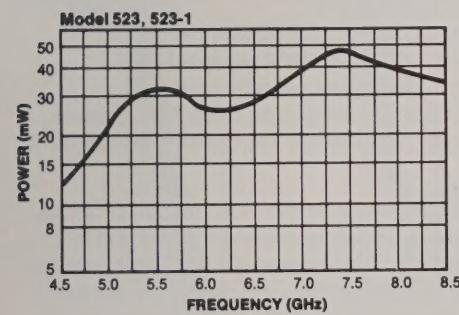
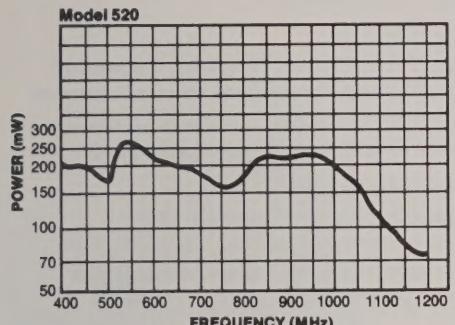
The Series 520 represents an advance in transistor and Gunn diode technology which permits generation of microwave power by solid state devices at power levels suitable for replacing medium power triode and klystron oscillators. The seven solid state models in the Series 520 are smaller, lighter, consume less power and are generally more economical than their vacuum tube counterparts.

Models 520, 521 and 522 each employ a transistor oscillator, tuned by a capacitively loaded transmission line. In Models 523, 523-1, 523-2, 524 and 525, a Gunn-effect oscillator operating in a fundamental mode coaxial cavity is used.

The total 0.4 to 18 GHz frequency range is covered by the individual ranges of the seven models, from the Model 520 with a range of 0.4-1.2 GHz, to the Model 525 with a range of 12.0-18.0 GHz.

## POWER OUTPUT

Typical power output for specific models varies from 20 mW to 150 mW, over the frequency range of each particular model. Typical variation of output power with frequency for each model is shown below.



## Specifications, Series 520

MODEL NO.	520	521	522	523	523-1	524	525
Frequency Range, GHz (continuous)	0.4 to 1.2	.85 to 2.15	2.0 to 4.0	4.0 to 8.0	4.5 to 8.5	8.0 to 12.5	12.0 to 18.0
RF Power Output (into 50 ohms)							
Minimum	50 mW	10 mW	10 mW		10 mW	20 mW	5 mW
Typical	150 mW	50 mW	30 mW		20 mW	40 mW	20 mW
RF Level Control (internal and external)	25 dB	20 dB	20 dB		20 dB	15 dB	10 dB
Amplitude Modulation							
Internal Depth <sup>①</sup>	100%	20 dB	20 dB		20 dB	15 dB	10 dB
External Depth	25 dB (24V input)	20 dB (20V input)	20 dB (20V input)		20 dB (20V input)	17 dB (20V input)	14 dB (20V input)
Rise Time, max.	1 $\mu$ sec.	1 $\mu$ sec.	1 $\mu$ sec.		5 $\mu$ sec.	5 $\mu$ sec.	5 $\mu$ sec.
Frequency Stability <sup>②</sup>							
Short Term (5 min.) <sup>③</sup>	0.001%	0.0015%	0.0015%		0.004%	0.003%	0.002%
Long Term (1 hr.)	0.006%	0.006%	0.005%		0.007%	0.008%	0.009%
Temperature (per $^{\circ}$ C, in range 10 $^{\circ}$ to 50 $^{\circ}$ C)	0.006%	0.006%	0.006%		0.007%	0.006%	0.007%
Pulling (at mid-band, due to 3:1 VSWR <sup>④</sup> )	0.02%	0.01%	0.05%		0.08%	0.06%	0.10%
Line Voltage	0.001% per 10-volt change in the range 100 to 120 volts.						

<sup>①</sup> Variable over at least 100 Hz either side of 1 KHz square wave.

<sup>③</sup> After 15 min. settling time.

<sup>②</sup> Typical, after 1-hr. warmup in stable environment.

<sup>④</sup> Except for Models 520 and 521, where VSWR is 1.25:1.

The following specifications are the same for all models unless otherwise noted:

Readout Accuracy .....  $\pm 1\%$  (except  $\pm 2\%$  for Model 520 at frequencies from .4 to .55 GHz)  
 Harmonic Level .....  $\geq -20$  dB below fundamental  
 Output Impedance ..... 50 ohms  
 Available Outputs ..... CW, square-wave

Output Connectors ..... Female, type N  
 Power Requirement ..... 100-120V or 200-250V, 50-60 Hz  
 Dimensions ..... 3 $\frac{3}{8}$ " H x 8" W x 11 $\frac{1}{2}$ " D  
 (98mm H x 203mm W x 292mm D)  
 Weight ..... 8 lbs. (3.4 kg)



# General Terms and Conditions of Sale

## How To Order

Please order by model number, option number (where applicable), and product name to avoid any misunderstanding.

Telephone orders will be accepted and processed immediately. However, shipment cannot be made until a confirming written order is received, either by means of a standard purchase order form or a TWX containing the following information as a minimum:

- Purchase order number.
- Ship to and bill to addresses.
- Description, model number and unit price.
- Name of authorized representative of purchasing department.
- Method of shipment.
- Amount of insurance on shipment.
- Sales/use tax status of order.

## Where To Order

Address all purchase orders to:

General Microwave Corporation  
155 Marine Street

Farmingdale, New York, USA 11735

Telephone 516-694-3600 • TWX 510-224-6406

or in care of our Engineering-Sales Representative in your area. Determinations of prices, terms and conditions of sale, and final acceptance of orders are made only at the factory.

## Domestic Terms

Terms of payment are Net 30 days, subject to approval of credit. If credit has not been established, please provide payment in full or authorization to ship C.O.D. All prices are FOB Farmingdale, New York and include packing to good commercial practice.

## Export Terms

Irrevocable sight letter of credit engaged and accepted by Chemical Bank, New York or prepayment by deposit in any branch of the Chemical Bank, payable to the account of General Microwave Corporation, Farmingdale, New York, Account No. 893-002461.

## Specification and Price Changes

The right to discontinue any item and to change specifications or prices at any time without notice is reserved.

## Equipment Warranty

General Microwave Corporation warranties all parts of equipment of its manufacture to be free from defects caused by faulty material or poor workmanship. This warranty excludes electronic tubes, batteries, natural rubber and material normally consumed in operation unless such excepted items fail as a result of improper application by General Microwave Corporation.

Liability under this warranty is limited to the obligation to repair, or, at General Microwave's sole option, to replace without charge, FOB General Microwave's Plant, any part found to be defective under normal use and service within the time periods shown below, provided:

- (1) General Microwave Corporation is promptly notified within the warranty period in writing upon discovery of such defects;

## Minimum Order

The minimum order is \$25, unless prepayment is received. The minimum line item charge is \$5.

## Source Inspection Charge

A surcharge will apply on all orders requiring inspection at the factory. Consult factory for amount. When Customer Source Inspection has been imposed, there is no extra charge for concurrent Government Source Inspection.

## Domestic Shipping Methods

Unless specific instructions accompany the order, shipment is made via UPS or Parcel Post, insured for the full value of the shipment. Air freight shipments will be made FOB origin, freight charges collect.

## Overseas Shipping Method

Unless otherwise specified on the face of the order, shipment will be made via air freight using a freight forwarder selected by the seller, with all charges, including forwarder, inland freight, air freight, insurance, consular and banking fees charged to the buyer's account.

## Service

Units returned for repair must be returned freight prepaid, FOB factory. If warranty repair is applicable, the unit will be repaired and returned freight prepaid, FOB destination. If warranty repair is not applicable, the customer will be advised of the repair charges and his authorization to proceed awaited before any costs are incurred. Non-warranty repairs will be returned FOB Farmingdale, N.Y.

Returns from outside the United States must be made Free House/Free Domicile. Note that except where prior authorization has been received from the factory, collect shipments will be automatically refused by our receiving department.

## Defense Department Priority System

General Microwave is obligated to process all orders based on their relative priorities. Accordingly, all ratings should be included on advance and confirming purchase orders.

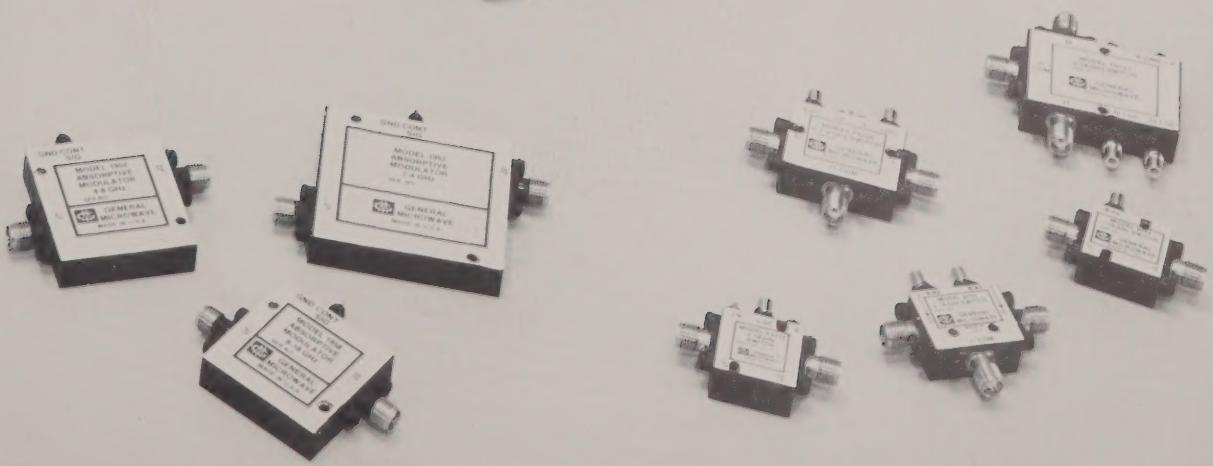
## Returns

Standard instruments or components returned for credit within 60 days after shipment in a like-new condition will be accepted subject to a restocking charge of \$25 plus 12% of selling price in excess of \$100.

- (2) The original parts or equipment are returned to General Microwave Corporation, transportation charges prepaid;
- (3) General Microwave Corporation's examination shall disclose to its satisfaction that such defects have not been caused by abuse after delivery; and
- (4) Warranties shall not apply to items which have been repaired or altered by others than General Microwave Corporation or its authorized agency.

The period of warranty is one year after delivery of the instrument to the original purchaser.

The warranty period shall not include any period of time the unit or part fails to perform satisfactorily due to such defect, and any unit, part or component repaired or replaced by General Microwave pursuant to this warranty shall itself be guaranteed as specified above.



*Where Quality Is Everyone's Business*



**GENERAL MICROWAVE CORPORATION**

155 Marine Street, Farmingdale, N.Y. 11735 • (516) 694-3600 • TWX (510) 224-6406